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- radio wave propagation
- eight channel memory scanner
- microwave network for multimode communications
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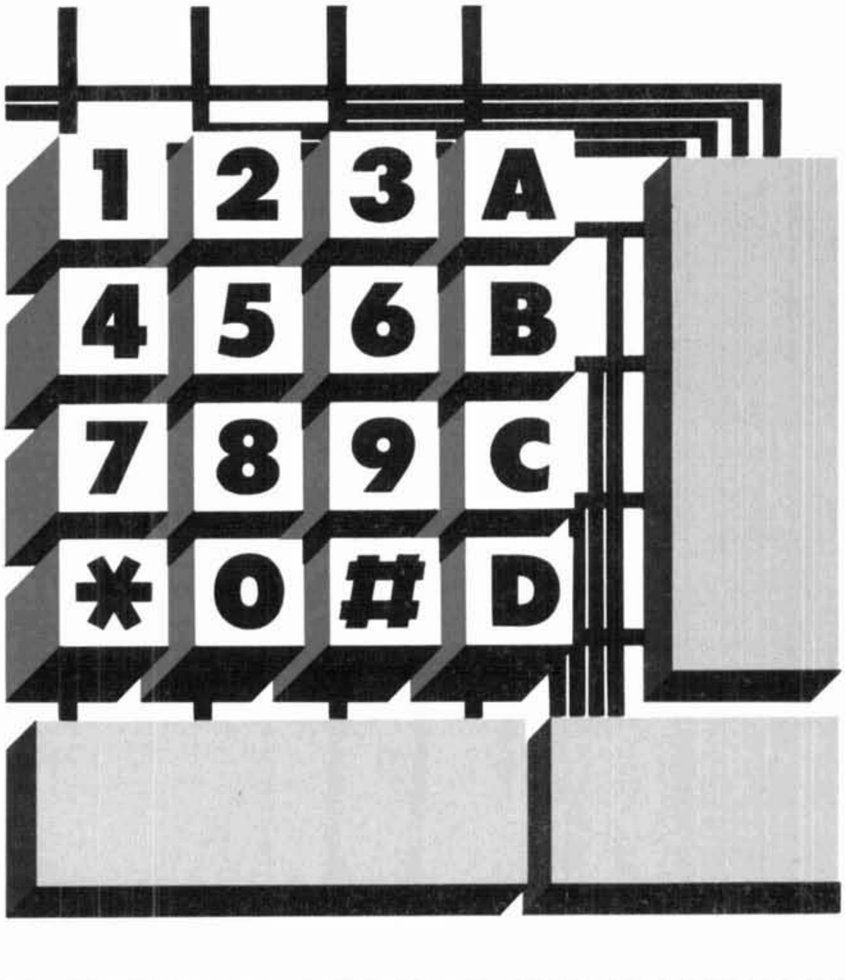
hr

focus on communications technology

a portable auto-dialer



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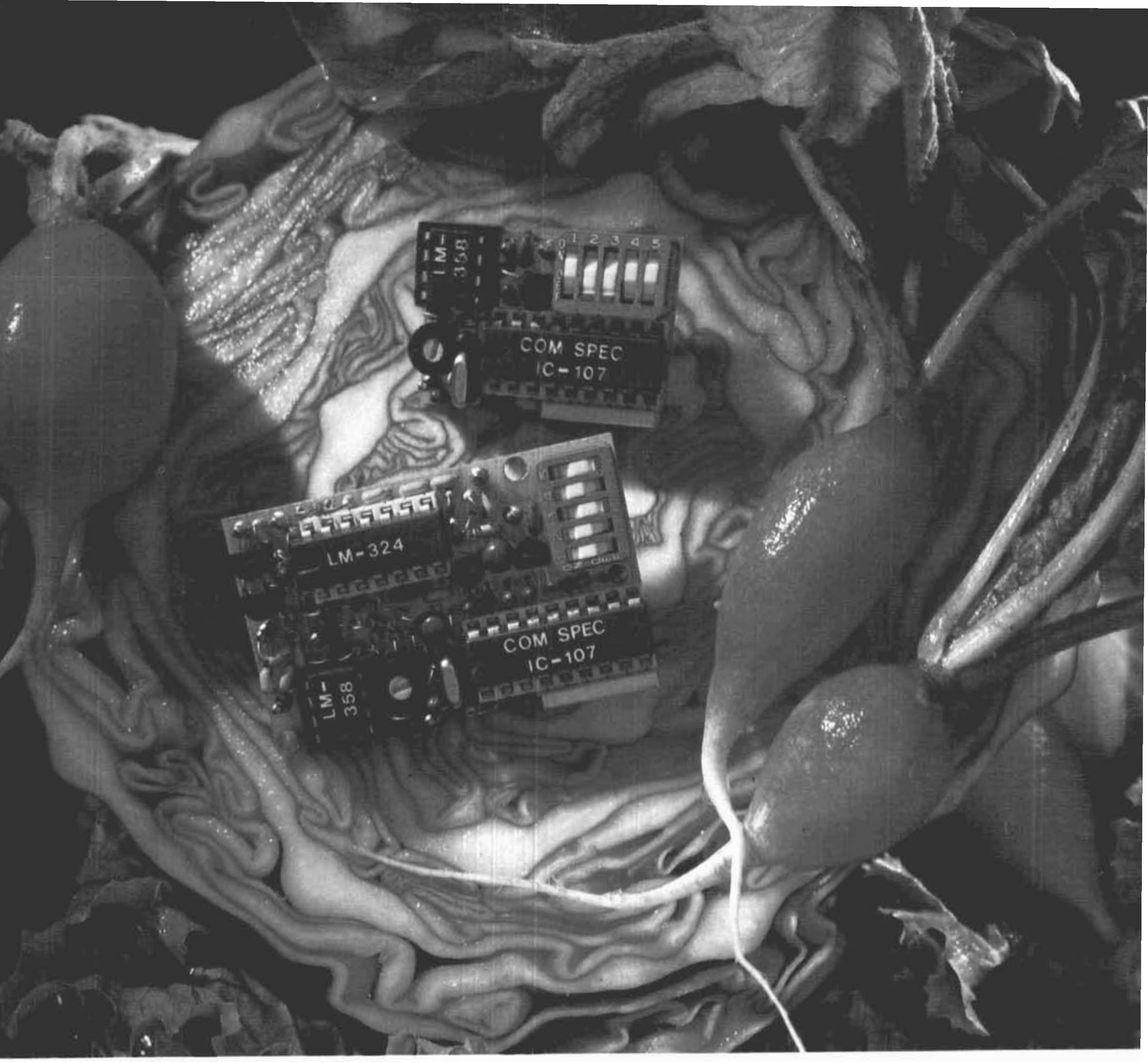

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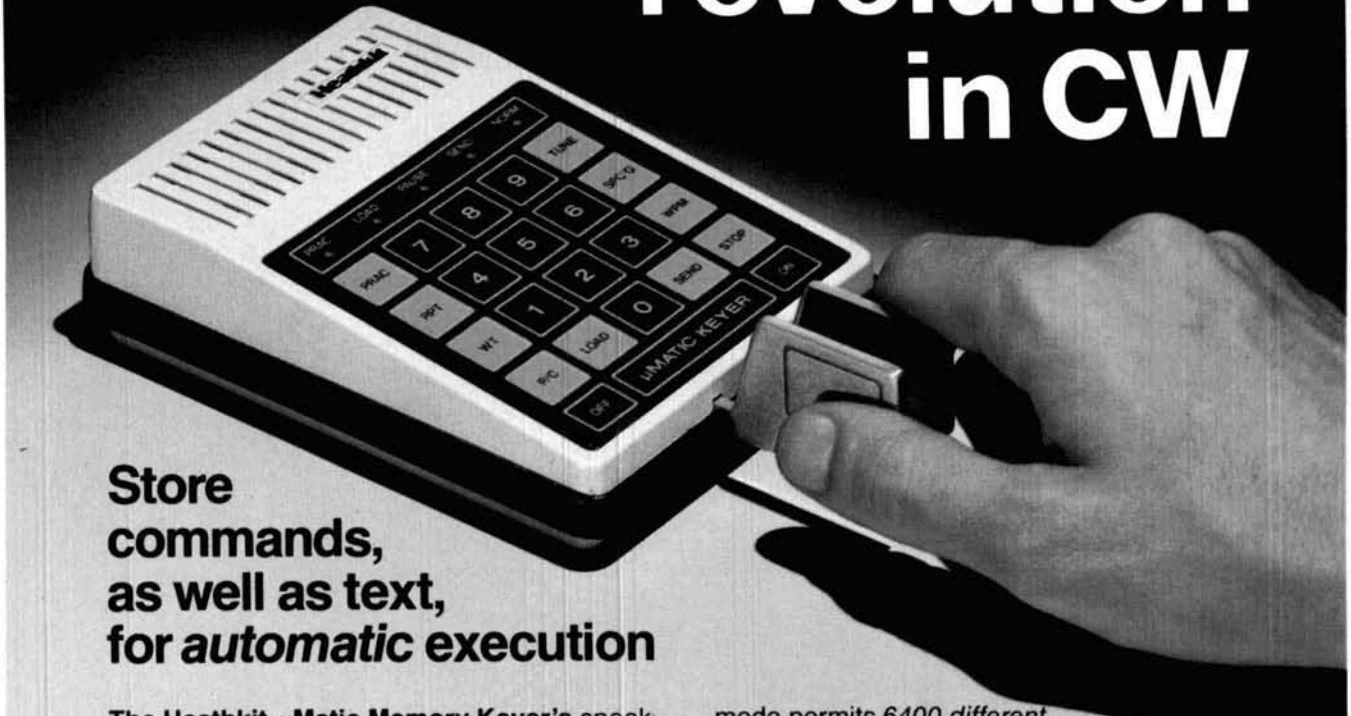

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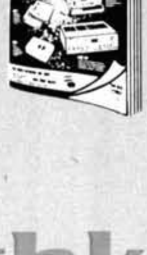

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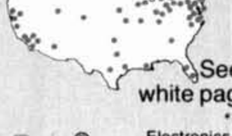

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magazine

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Observation & Opinion

A basic knowledge of electronics and radio communications, moderate skill with Morse code, and a nodding acquaintance with the FCC's rules and regulations. That's all it used to take to get an Amateur license and put a station on the air. Not any more; today's Amateur had best add a couple years of law school to his basic preparation effort. The way things have been going in the courts and with local lawmakers, it's going to take that and more, if we're going to defend our right to get on and stay on the Amateur bands!

Amateur Radio has never been a stranger to legal problems. Zoning restrictions and antenna height ordinances, restrictive covenants, uncooperative landlords and even an occasional lawsuit over TVI have made life miserable for a small number of Amateurs at times. Today, however, the threat to our hobby and service is far more pervasive. Let's look at some recent happenings that could seriously hurt us all.

In California last year, the state legislators passed a law making it a crime to make or sell *any device or component that could be used in a device that could be used to unscramble pay-TV signals.* This spring the Chicago City Council proposed an ordinance that would *require the builder of any antenna structure to spend hundreds,* if not thousands, *of dollars on fees and paperwork before beginning construction* on his proposed antenna. In mid-June a federal judge in Minneapolis *issued an injunction preventing stores in that area from selling antennas that could be used to recieve Home Box Office movies* (transmitted in the 2-GHz band). The lawyer for the HBO distributor said they also planned to ask the court to force owners of such antennas (which could, of course, be used by Amateurs on the 2300-2450 MHz Amateur band) to sign over ownership of the antennas to HBO and pay HBO the $20 monthly fee charged to HBO subscribers. Finally, the city of Burbank, Illinois, passed an ordinance this spring that not only severely restricts the use of Amateur and CB antennas (and places a one-year moratorium on their construction) but also makes it a crime to cause any type of radio interference!

In the case of Burbank, a suburban Chicago community of about 40,000, the operation of *any* transmitter that interferes with *any* TV, "musical instrument, phonograph or other machine or device designed for the production or reproduction of sound" is now a criminal offense. The penalty is a fine of $25 to $1000 for each violation or each day the violation continues, and those violating the ordinance are also subject to arrest. The same sanctions apply to violators of the new antenna restrictions; though existing structures may (with some limitations) be grandfathered, any Burbank Amateur or CB operator who puts up an antenna during the next year may well find himself arrested and fined!

The Burbank ordinance is perhaps the most direct challenge to Amateur Radio operators that has been made in many years, and reaction from the Amateurs of Burbank and surrounding communities has been swift and strong. Under the leadership of Burbank DXer WA9EKA, Burbank Amateurs have pledged over $2,000 toward mounting a court challenge to the ordinance, and retained the services of W9WU, a Chicago attorney who's been very active in a number of Chicago area antenna controversies. The Wheaton Community Radio Amateurs, sponsors of the annual Wheaton Hamfest, have contributed $500 to the battle, and a number of other area groups and individuals are also supporting the fight. The ARRL has been asked for its support and participation in what is shaping up as a lawsuit that could be a crucial landmark confrontation between the rights of individual Amateurs and repressive local regulations. Despite several meetings on the subject and the enthusiastic support of a number of Directors, the League still seems uncertain as to just what role it should play.

A well-mounted court fight is expensive. It's estimated that this one will run at least $10,000, and costs could reach $20,000 before it's settled. This is our fight, not just their fight — to challenge this law in court and lose because of inadequate financial support would establish a precedent that would be a nationwide disaster for Amateur Radio. If Burbank prevails, this ordinance could be the model for similar restrictions across the country!

On a happier note, a little forewarning and preparation can often forestall an expensive Burbank-type confrontation. In the case of the Chicago antenna ordinance, a few words to key aldermen by W9WU and other concerned Amateurs while the ordinance was still being drafted resulted in language that requires only a building permit for towers used by stations licensed under Part 97 of the FCC rules. The first Amateur Radio installation under Chicago's new regulations was a 70-foot Hy-Gain crank-up, installed June 7 by WA9IVU with the City of Chicago's full approval.

Remember, Burbank's fight is your fight. Send your contribution to the Burbank Tower Fund, Roger Borowski, WA9EKA, Chairman, 6107 West 80th Place, Burbank, Illinois 60459.

Joe Schroeder, W9JUV
associate editor

comments

not for beginners

Dear HR:

I have just ordered a Datong FL-2 because of the fine paper by Dr. Tong in the November, 1981, issue of *ham radio*. I would like to encourage this type of presentation by designers of commercially available Amateur equipment.

I am much less pleased with the papers by Jan K. Moller, K6FM, ["Understanding Performance of HF Receivers," November, 1981, p. 30]. The title implies that the author is trying to explain something to the reader who is not technically sophisticated. I feel he did not present the material on IMD at a low enough level. I have read his paper several times but still do not understand IMD intercept, etc.

I'm aware that many of the papers in your journal are not addressed to beginners, but titles that start off with "Understanding . . ." should impart that understanding.

I guess I am frustrated because I read the paper eagerly, expecting to fill a recognized void in my knowledge, and I was not able to do so.

Joseph A. Worrall, M.D., KL7HT
Fairbanks, Alaska

In the article about receiver performance data, the plan was to provide a brief explanation of the common technical terms found in an HF receiver's data sheet. I also wanted to show how this data can be interpreted in appraising the capabilities of the various sets on the market. The very complex combination of rf preamplifier performance and first stage characteristics — which together determine the receiver's behavior with regard to unwanted signals — was outside the scope of the article.

A majority of hams live in or near population centers, with their accumulation of commercial transmitters (mobile as well as fixed), broadcast, TV, police, paging, truck dispatch, and so forth. The possibility of stations outside the Amateur service generating harmonics or beatnotes that fall in an Amateur band is great. Fairbanks is probably better than most cities, but try to tune across the 80-meter band and see if you cannot find a few strange signals that are caused by non-ham signals beating against each other. This is what has generated the interest in the term "inter-modulation distortion," or IMD for short. Naturally, two ham signals off the frequency to which you are tuned can cause the same beatnote if their frequency relationship is right (see the article for the formula). I am not entirely happy with the word distortion *in this connection; to* distort, *to me, means to change unfavorably — but that happens to be the official term.*

The reason we exemplify the third-order IMD is that this one is the most troublesome in actual receivers. Higher harmonics resulting in frequencies nearby the desired one are usually very much smaller in amplitude, partly because the front-end (rf stage) selectivity of the receiver keeps them down.

The whole problem lies in the fact that there is no such thing as a perfect first mixer. The diode bridges used today are much better than the old tube mixers which, in the early days, commonly had two stages of tuned rf in front of them for protection. The trouble is nonlinearity, of course, which will cause the mixing of any incoming signals. The data in the article, which incidentally is based upon the Kenwood TS-830S, points up the quality of this set by the fact that the off-frequency signals will have to be about 50 dB over S9 each *to generate an audible beatnote on the frequency to which you are listening (tuned).*

The intercept point expression is harder to fathom, to be sure, and is strictly a theoretical definition. I mentioned it simply because it is beginning to appear in reviews of new equipment. The idea is that the slower the ratio of build-up of intermod beatnotes for increasing rf input levels, the higher the intercept point value in dBm. Once the point has been established, you can calculate the receiver's behavior for the signal levels that are typical for on-the-air operation.

I hope the above comments have been of help to you in understanding my article.

Jan K. Moller, K6FM
Simi Valley, California

2-meters outlawed?

Dear HR:

Two-meter Amateur Radio outlawed? The essay on page 10 of the March, 1982, issue is ominous enough, but it just touches the tip of the issues raised by the question of interference by Amateur stations to cable television systems.

One notable fact is that while virtually any Amateur station in the 2-meter band can cause interference, only *one* CATV channel is affected (Midband Channel E). This one channel covers the entire 2-meter band (144-149.7 MHz). It would indeed be unfortunate if the entire 2-meter community were forced to vacate in order to preserve a single CATV channel.

Another point is even more ominous: the problem is not confined to the 2-meter band. Cable channels K and XX fall in the Amateur 220 and 440-MHz bands. If a precedent is established resolving 2-meter interference to CATV, is it not just a matter of

(Continued on page 63)

presstop de W9JUV

THE HOUSE VERSION OF K7UGA'S COMMUNICATIONS ACT REWRITE, HR.5008, unanimously passed the House Committee on Energy and Commerce June 3 without any restrictions on commercial involvement in Amateur exam preparation. The provisions permitting the FCC to regulate RFI susceptibility also remained intact, despite vehement opposition from the Electronic Industries Association. Though the bill is already extremely favorable to Amateur Radio with its provisions for Amateur participation in monitoring and exams, it's also hoped that additional benefits can be obtained by having language strengthening the case for federal preemption added to the accompanying committee report.

In Late June HR.5008 Had Still Not reached the House floor, but when it does quick passage seems certain. After that the differences between the House version and S.929 still must be reconciled, but it may reach the President for signature by the end of July.

A Pennsylvania Preemption Bill, which would remove most Amateur antennas in that state from local control, has been stalled in committee since early June. Pennsylvania Amateurs are urged to check with their representatives to help get it moving again.

A NO-CODE AMATEUR LICENSE STILL LOOMS large at the FCC, with the topic scheduled for discussion at the Commission's July 1 agenda meeting. Personal Radio Bureau Chief Jim McKinney touched on the subject at the annual AFCEA Convention Amateur Radio luncheon in Washington mid-June, pointing out to the 180 or so attending that a no-code license may well be what's needed to attract today's computer-oriented youngsters to Amateur Radio.

Four Alternatives Are Considered Likely in any Commission proposal on no-code. One, an entry level "Communicator" license, was previously rejected by Amateurs when restructuring, Docket 20282, was under consideration. Another, a very high-level "Experimenter" class license, has not proven popular in Canada where it was introduced to encourage the development of packet radio. A third alternative that's likely to be received favorably by the Commission, since it would have little impact on the FCC's limited resources, would be to simply eliminate the code requirement for the Technician license and let it become the no-code license. The fourth alternative would be to reject no-code entirely.

It's Certain That No-Code Is Going to be proposed to the Amateur community again, if not already by the time this sees print almost certainly by the end of 1982.

6 AND 10-METER REPEATER ERP LEVELS have now been changed to agree with those on 2 meters, by an FCC Report and Order on PR Docket 81-697 released June 22. The new effective radio power limits vary from 100 watts for antennas over 1000 feet above average terrain to 800 watts for those under 50 feet, and became effective June 29.

PROPOSED PHONE BAND EXPANSION ON 20 METERS and the other HF Amateur bands is still open for comments with the due date now extended to August 16. In addition to proposing opening 20 meter phone down to 14150 and shuffling operator class privileges on that band, the FCC is also soliciting comments as to possible changes in the other HF phone bands. The editorial in May QST has a discussion of some of the issues involved.

An Original And Five Copies of Comments on PR Docket 82-83 must be at the Commission by August 16. Reply Comments are due September 16.

20 kHz 2-METER CHANNEL SPACING has now been adopted by Amateurs in Wyoming and Utah, bringing them into agreement with the Pacific Northwest and western Canada. Arizona and Nevada are also reported to be considering a similar change, which would leave California the only state west of the Rockies to retain 30/15-kHz spacing on 2 meters.

ARRL VHF CONTEST RULES WILL probably remain the same for September as they were in June, despite some discusssion that grid squares would replace sections for the next run. An ad hoc committee has been working on the change, but will probably not be finished in time to implement any alterations before the September fray.

220 MHz CW/SSB Enthusiasm is growing rapidly, if June contest activity was any indication. W1FC on Pack Monadnock boosted their best previous 220 multiplier by 11 to 28 sections, three on E-M-E, and W2FZ logged 24 sections compared to a previous high of 22. Some of the increase was due to an excellent aurora opening, of course, and some to rules changes permitting single band entries.

THE FORMER WB6JAC HAS BEEN CONVICTED by a U.S. District judge on two of three felony counts of broadcasting obscene, indecent and profane language plus four counts of operating a transmitter without a license. His license had been revoked by the FCC a year ago for jamming activities; his subsequent operation resulted in his arrest April 30 by U.S. marshals and FCC officials. Sentencing was set for the end of June, with a prison term and heavy fine considered likely.

THREE INTERNATIONALLY KNOWN AMATEURS BECAME SILENT KEYS in June: W2PV, W3KT, and HS1WR. Jim Lawson, W2PV, was an antenna expert whose fine ham radio articles made him as well known as did his outstanding contest station's signal. Atlantic Division ARRL Director Jesse Bieberman, W3KT, served Amateur Radio as both an ARRL director and Third District QSL manager, and was himself a top DXer. Gen. Kamchai Chotikul, HS1WR, was one of Thailand's most active Amateurs and, as president of the Radio Society of Thailand, one of the strongest pro-Amateur Radio voices in both his own country and all of Southeast Asia.

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FF501dx	Low pass filter	34.00
QTR-24D	Deluxe 24 hour world clock	49.00

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FRA-7700	Indoor active antenna	59.00
FF-5	500 KHz VLF low pass filter	20.00
DC-7700	DC kit for FRG-7700	8.00
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FL-2010	2m 10w amplifier	99.00
TA-2	19" telescoping antenna	9.40
FT-708R	.2/1w 440 FM HT/TTP/chgr/batt	359.00
FL-7010	440 10w amplifier	149.00

Accessories for FT-208R/FT-708R

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NC-8	15-hr/4-hr desk charger/AC ps	99.00
LCC-8	Leather carrying case	35.00
FBA-2	Batt sleeve for FNB-2 in NC-7/NC-8	6.25
FBA-3	Sleeve; FT-208R/708R in NC-1A/3A	12.00
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YM-24A	Speaker microphone	39.00
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MMB-10	Mobile mount 208/708	15.00
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TS-32	Syn. CTCSS encoder/decoder	75.00
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FL-2010	2m 10w amplifier	99.00
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LCC-90	Leather carrying case	39.00
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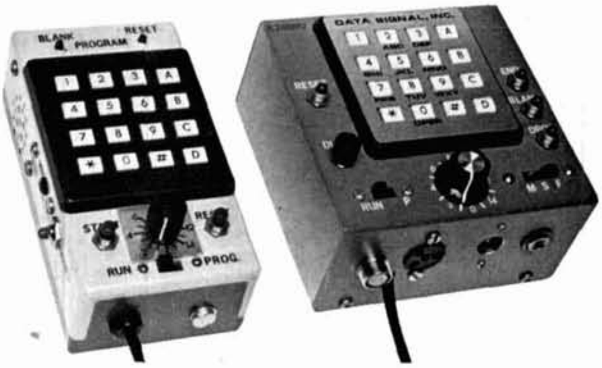


Of two versions of the auto-dialer built by the author, the one on the left was housed in a plastic case and the other in a standard LMB metal box. Both units are used in the author's cars, but only the one on the right has provisions for using the car battery as a supply. The additional connectors are for using the auto-dialer with other rigs.

a portable Touchtone™ auto-dialer

Compact design using standard CMOS devices is featured in this accessory for mobile operation

Repeater autopatch facilities are an exciting and important aspect of Amateur Radio. But for the mobile operator, dialing while driving, particularly at night, is both dangerous and inconvenient. Commercial dialers for Amateur use do exist, but they haven't become very popular. Perhaps they are too difficult to use or program, have high current demands for memory retention, or lack versatility.

The do-it-yourself autopatch dialer described here doesn't have these problems. It's portable and compact, uses standard CMOS parts, and has very low battery drain. It's a snap to program, and doubles as a full-feature manual encoder as well.

description

Using CMOS memory, the dialer can store sixteen, sixteen-digit telephone numbers. Its keypad incorporates all sixteen Touchtone™* digits. Battery drain in standby, including memory retention, is 2 microamps. A standard 9-volt transistor battery can power the unit from nine months to a year, depending on

By Alan Lefkow, K2MWU, 17 Jacobs Road, Thiells, New York 10984

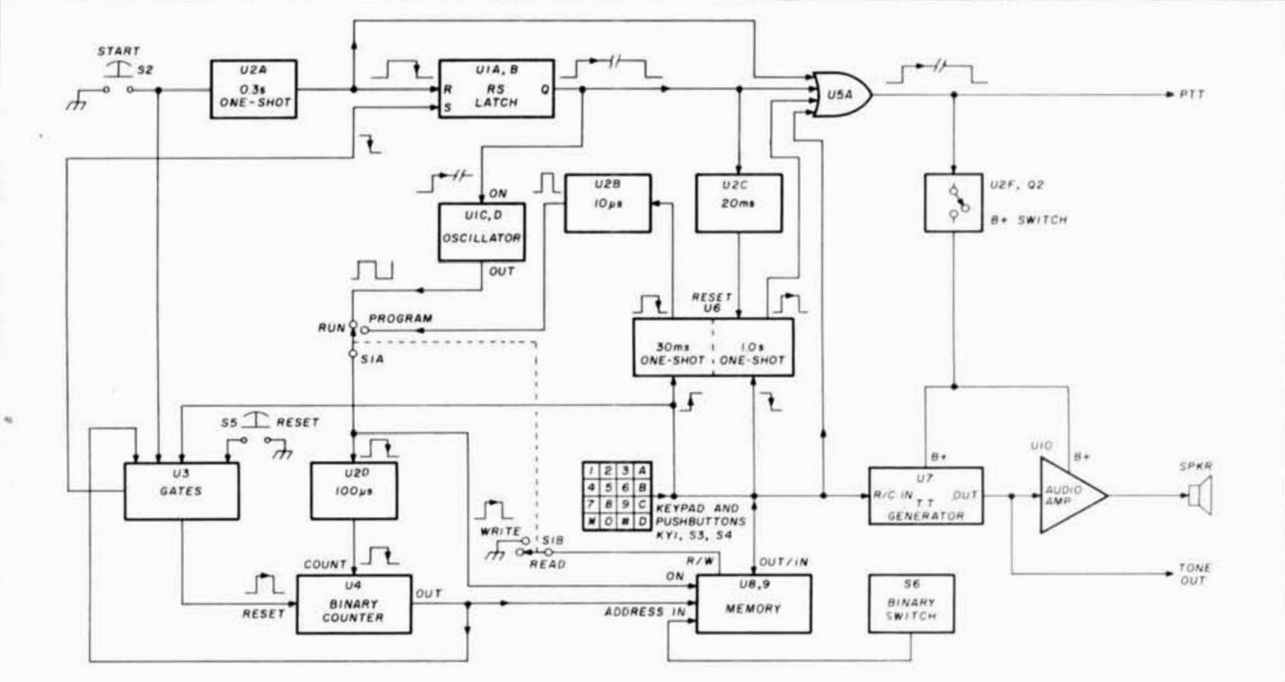


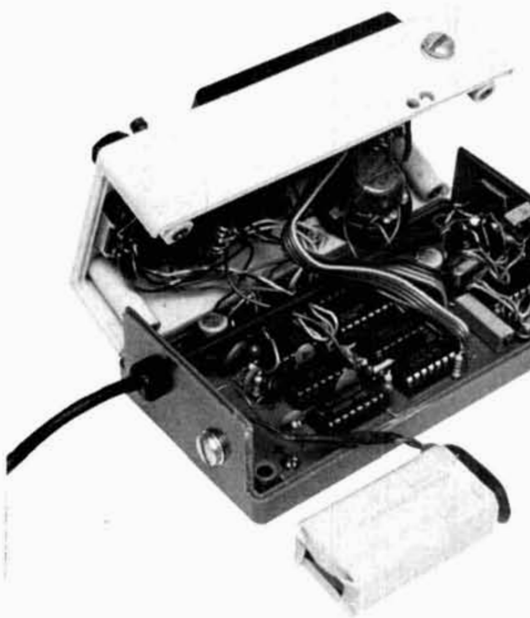
fig. 1. Block diagram of the portable auto-dialer. Circuit features CMOS memory which can store sixteen 16-digit telephone numbers and provides three switch-selected dialing speeds.

use. Three switch-selected dialing speeds are provided: 55 milliseconds per digit for state-of-the-art patches, 250 milliseconds per digit for slower patches, and 1 second per digit for those machines that use tone-to-rotary-pulse converters. To ensure full capture of the repeater, dialing tones are output 300 milliseconds after the dialer keys the transmitter PTT line.

Programming is easy: the desired telephone number is simply dialed in. Pauses can be inserted, and with a simple addition to the circuit, a carrier-drop can be programmed in the middle of a dialing sequence for those patches that require it. The dialer can also be used manually as a full function Touchtone™ pad, including automatic PTT and a 1-second hang-on time after each digit. A side-tone amplifier and speaker are included for monitoring the tones.

circuit

The heart of the circuit is the Harris Semiconductor HM3-6562-9 CMOS memory. (Refer to the block diagram and schematic, **figs. 1** and **2**). This 1k RAM is configured as 256 x 4 and comes in a compact sixteen-pin package. Its common input/output lines are another asset. The chip comes in several versions. The -9, industrial version, is used here instead of the slightly cheaper -5, commercial version, for two reasons. First, standby current drain is an order



The auto-dialer in this plastic case uses an earlier version PC board that is a hair narrower than the board shown in *fig. 3*. The battery fits right on top of the ICs. Note the 1-inch speaker in the upper right corner of the cover.

*Touchtone is a registered trademark of the American Telephone and Telegraph Company.

of magnitude less for the -9, typically 1 microamp per chip. Second, although the chip is specified for a maximum allowable voltage of 8.0 volts, the -9 version is tested by the manufacturer to withstand 10.0 volts. That lets us use a standard 9-volt transistor battery to power the unit.

Two memory chips, U8 and U9, are used — one for the column and one for the row inputs of the Mostek Touchtone™ generator chip, U7. U7 has built-in pull-down resistors on both row and column inputs and can be directly interfaced to U8 and U9. This simplifies the dialer's design. U10 is a popular audio amp designed for battery operation. With a miniature speaker, it provides audible feedback of tone output. R19 acts as a volume control, and C13/R23 form a parasitic suppressor during negative voltage swings. Both U7 and U10 are switched on by Q2 only during dialing or manual operation to keep standby current drain to a minimum.

programming

To program, U8 and U9 are switched to the write mode with run/program switch S1. U5b senses keyboard and pushbutton closures and triggers a 30-millisecond delay pulse formed by one half of U6. That delay covers contact bounce of the keyboard or pushbuttons. The falling edge of that pulse triggers a 10-microsecond write pulse, formed by R3, C16, and U2b, and is applied to the chip-enable (CE) lines of U8 and U9. (Holding the read/write, R/W, line low and pulsing the CE line has the same effect as the more familiar sequence of holding the CE line low

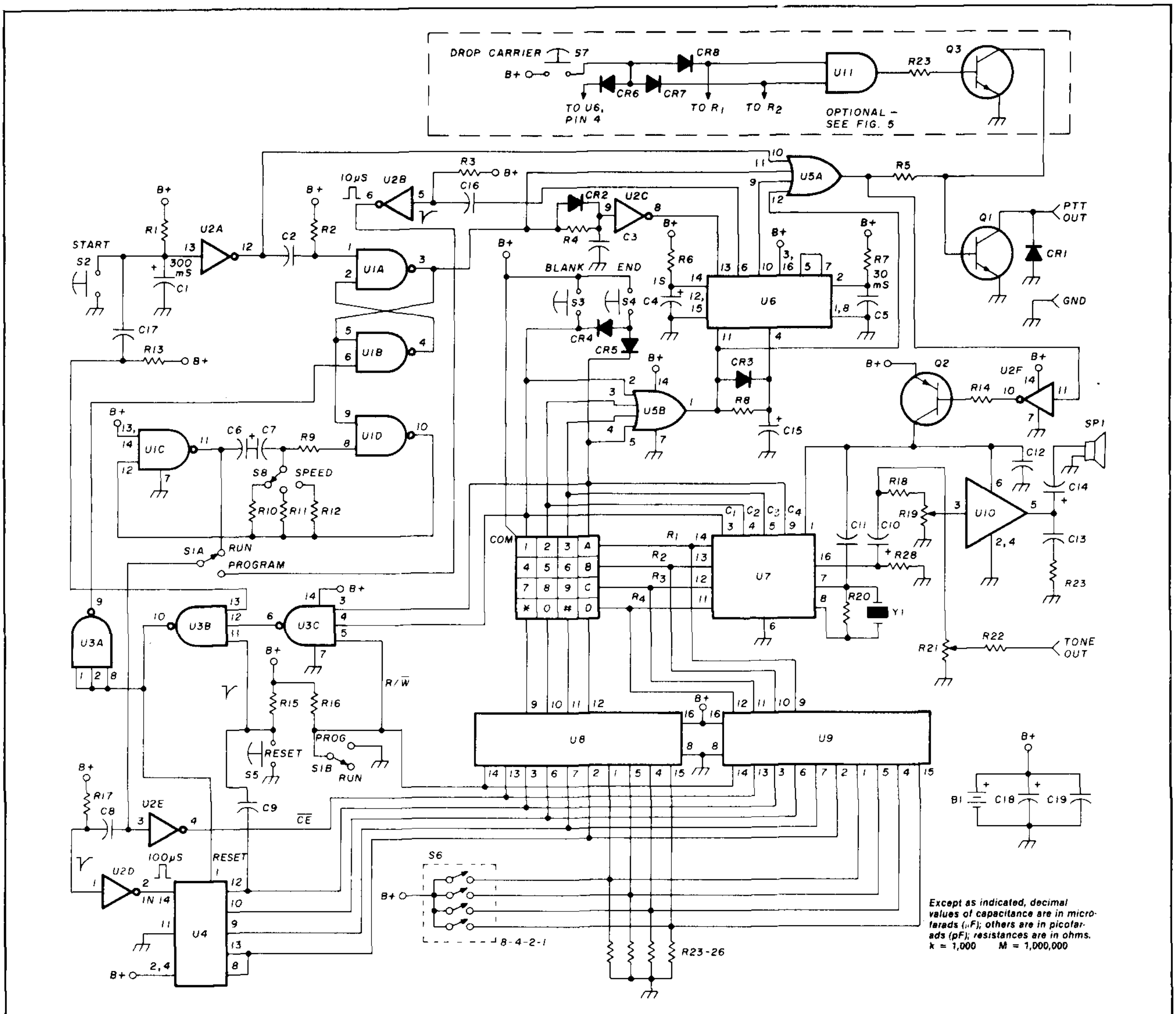


fig. 2. Auto-dialer schematic diagram. The design is simplified by taking advantage of direct interface capability between U7, the Mostek Touchtone™ generator chip, and the two memory chips, U8 and U9.

and pulsing the R/W line.) In turn, the falling edge of the write pulse is delayed an additional 100 microseconds by R17, C8, and U2d, and is used to increment binary counter U4 at the end of the write cycle.

During the write cycle, the respective key or button closure enters a logical one into the appropriate memory locations, and a logical zero elsewhere. A network consisting of CR3, R8, and C15 prevents any contact bounce caused by releasing a key or pushbutton from retriggering another write cycle. As U4 is incremented, its four output lines address each succeeding location in memory, for a total of sixteen digits. The other four memory address lines are selected by binary-coded switch S6, which determines which of sixteen possible telephone numbers is being programmed or dialed.

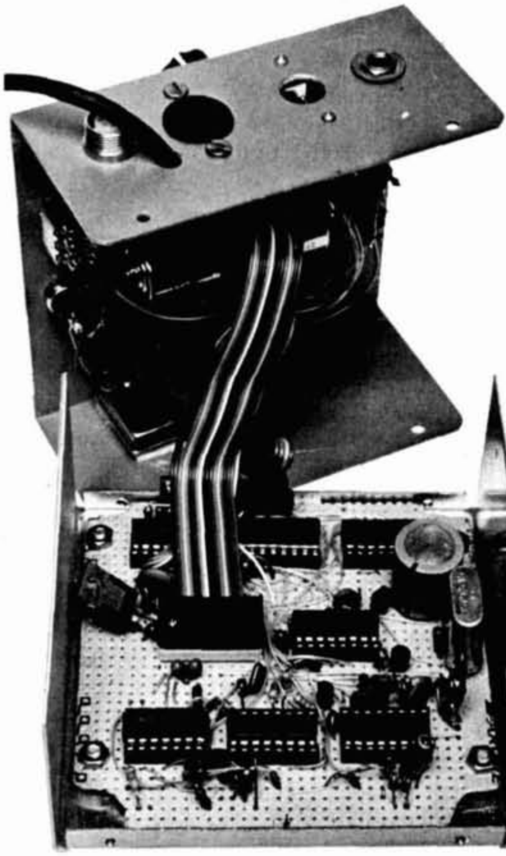
U7 does not produce any tones if only column inputs are actuated. The dialer uses that feature to produce a blank, for pauses, and an end-of-sequence code to stop dialing at the end of a number. The blank is programmed by S3, which is simply a column-1 input. END is programmed by S4, which keys both columns 1 and 4. (Two column inputs are necessary to distinguish END from normal key closures.)

dialing

The automatic dialing sequence is started by pushbutton switch S2. R1, C1, and U2a add a 300-millisecond delay before setting an RS latch formed by U1a and b, which starts the dialing. However, the PTT line is brought up as soon as S2 is depressed, and U7 and U10 are turned on through Q2. The RS latch holds Q1 and Q2 on after the delay has passed, and starts the square wave oscillator, formed by U1c and d. The first half of each cycle turns on U8 and U9, whose outputs actuate the appropriate row and column inputs of U7. The second half of the square wave provides the inter-digit time and increments counter U4 for the next digit. This sequence continues for sixteen digits or until an END is encountered. At an END, U3 resets the RS latch and U4, and stops the oscillator.

When the oscillator stops, however, it increments counter U4 one more count. To restore the counter to zero (say, for programming) or to abort a dialing sequence, S5 is provided as a reset key. Start switch S2 is also wired to reset U4 and the RS latch, and that eliminates the need to manually reset before dialing.

For manual dialing, you need only depress the keyboard keys. Releasing each key triggers a 1-second PTT hang-on timer using the remaining half of U6. A delay network consisting of CR2, R4, C3, and U2c prevents U6 from adding any hang-on time during an automatic dialing sequence.



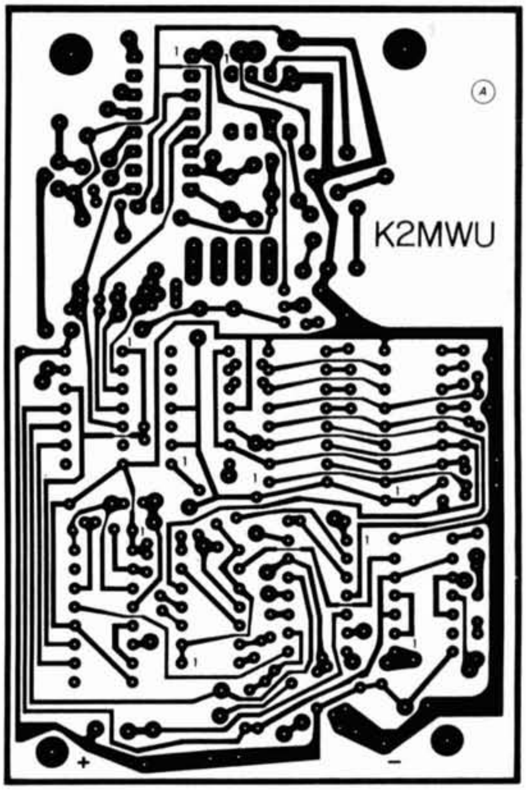
This version of the auto-dialer was built using point-to-point wiring. A ribbon cable and connector connects the two halves of the case together to facilitate servicing. A 4½-volt backup battery can be seen in the cover.

construction

Using the pattern shown (**fig. 3**) a PC board can be made, and the dialer built in a compact package. Several jumpers are shown on the component-placement diagram, a normal consequence of using a one-sided board with ten ICs. Parts layout is not critical, so point-to-point wiring can also be used. I've used both approaches with equal success. Sockets should be used for all ICs except U10, and normal precautions should be observed when handling CMOS chips. (I found U8 and U9 to be more susceptible to accidental damage than the other CMOS chips.) C12 should be mounted on the foil side, as well as most of the longer jumpers. Wire-wrap wire is particularly useful for jumpers — the insulation does not melt or recede during soldering. Note the land clusters for rows 1 to 4 and columns 1 to 4. These tie points are for connecting the keyboard and pushbuttons, as well as the column and row jumpers to U8 and U9 respectively.

Generally, parts values are not overly critical. Forgiving Schmitt-triggered buffers are used for pulse shaping, and RC combinations have been chosen to accommodate variations in parts values. The only components that will need adjustment and selection are R6, R10-R12, and R22. R22 affects the tone output level to your rig. A large value will lower the tone level but will not load your rig's tone input port. Typical values will be 10k to 100k; 10k will ensure adequate levels for most any rig.

R10 to R12 determine the dialing speeds, and dialing speed is directly proportional to these resistances. But for any given value, the dialing speed can vary over a 25 percent range because of chip-to-chip variations. Ballpark values for the speeds given earlier are 91k, 390k, and 820k. You can adjust these values by trial and error or by using an oscilloscope. When making these adjustments, note that the first cycle of the square wave oscillator will be longer than the rest, a characteristic of this type of oscillator. Similarly, the PTT hang-on time is directly proportional to R6; 330k provided 1 second in my unit.



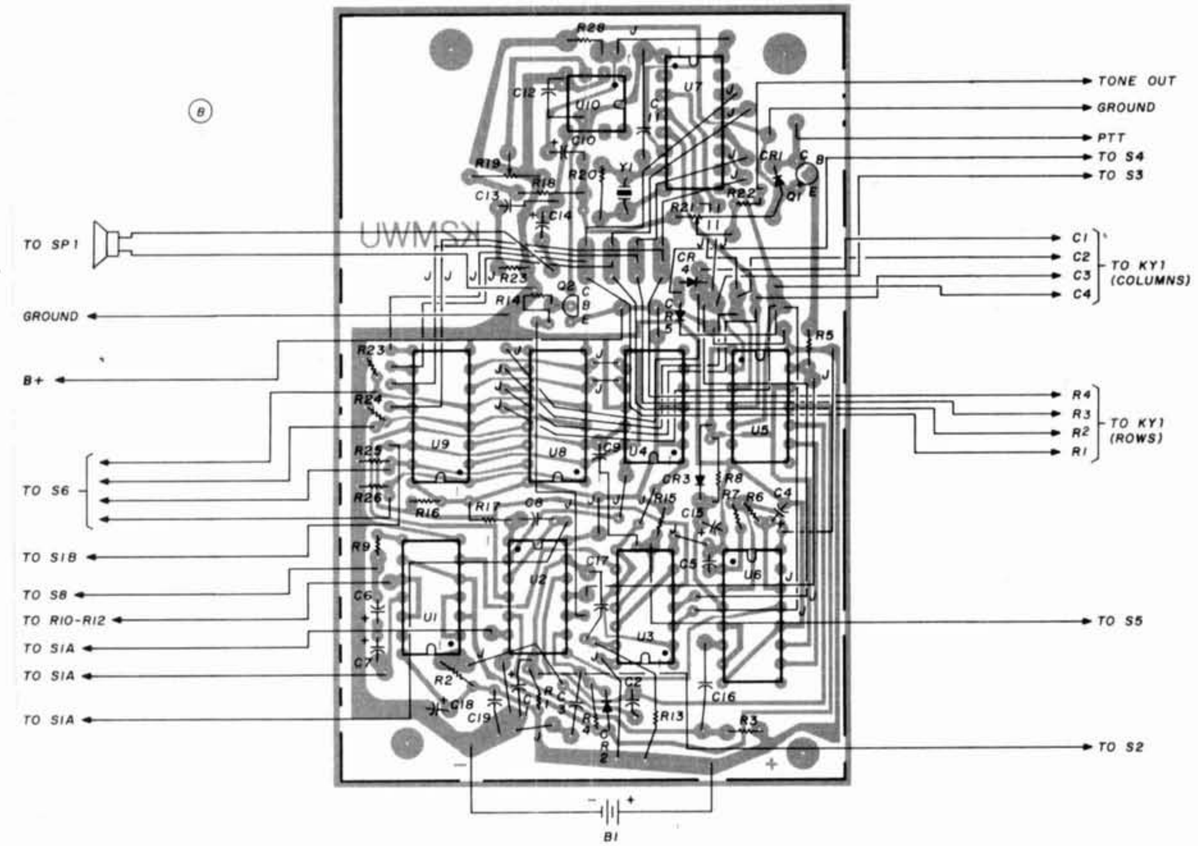


fig. 3. Foil side of the auto-dialer PC board, *A*, and component placement, *B*.

Dipped tantalum capacitors are used throughout the circuit because of their small size. To save space, a 1-1/2 or 1 inch speaker should be used for the side-tone monitor. The monitor needn't be loud to serve its purpose. Miniature pushbutton and slide switches also make for a compact unit. Instead of using a single-pole, three-position selector switch for S8, **fig. 4** shows how to use a double-pole three-position slide switch instead. Binary switch S6 may be harder to find in miniature form. I used an Eeco Series 21 Stripswitch and fitted it with a short shaft, but a thumb-operated Cherry T-50 series switch is almost as small and will work just as well.

Some autopatch facilities require that you drop your carrier between accessing the patch and dialing a number. A carrier-drop feature can be added with the circuit shown in **fig. 5**. The function is implemented by using two row inputs simultaneously, which, like two column inputs, does not produce any tones from U7. A two-input AND gate for U11 can be obtained directly or with a combination of gates. S7 is used to program the carrier drop. Note that this circuit is not provided for on the PC board.

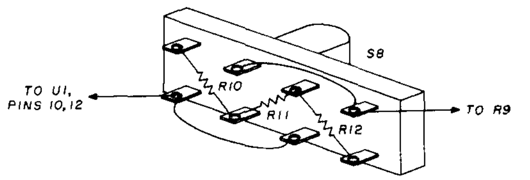


fig. 4. A three-position speed-selector switch for S8 can be made from a miniature double-pole, three-position slide switch. The switch terminals also provide tie points for R10, R11, and R12.

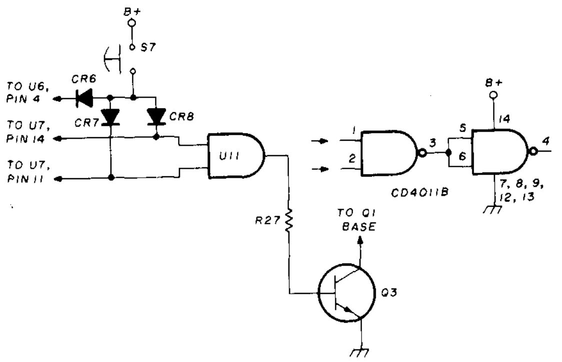


fig. 5. This optional circuit allows you to program a carrier drop for the length of one digit. U11 is a standard CMOS AND gate, such as a CD4081B. The AND function can also be implemented with standard NAND gates, as shown. Q3 turns off Q1, momentarily cancelling the PTT function.

B1	standard 9-volt transistor battery
C1	0.33 μF tantalum
C2	330 pF disc
C3,C5	0.02 μF disc
C4	3.3 μF tantalum
C6,C7	1.0 μF tantalum
C8,C9, C16,C17	100 pF disc
C10	2.2 μF tantalum
C11	10 pF disc
C12,C19	0.1 μF disc
C13	0.05 μF disc
C14,C18	100 μF electrolytic
C15	0.1 μF tantalum
CR1	1N4002 or equivalent
CR2-CR8	1N914 or equivalent
KY1	2-of-8 Touchtone™ keypad, with common
Q1	2N2222A
Q2	MPS3702
Q3	MPS3704
R1,R4	680k
R2,R16,R17, R23-R26	1M
R3,R13,R15	100k
R5,R14	3.3k
R6,R8	330k
R7	2.2M
R9,R20	10M
R10-R12	91k, 390k, 820k, respectively (see text)
R18	39k
R19	10k trimmer pot
R21	10k ten-turn pot
R23	10 ohms
R27	2.2k
R28	1k
S1	DPDT miniature slide switch
S2-S5,S7	miniature momentary pushbutton switches
S6	sixteen-position binary coded switch (8-4-2-1)
S8	one-pole, three-position switch (can use two-pole, three-position slide switch, see text)
SP1	miniature speaker, 4-8 ohms
U1	CD4011B CMOS quad two-input NAND gate
U2	74C14 CMOS hex Schmitt trigger
U3	CD4023B CMOS triple three-input NAND gate
U4	74C93 CMOS four-bit binary counter
U5	CD4072B CMOS dual four-input OR gate
U6	CD4528B CMOS dual monostable
U7	MK5086 Mostek CMOS Touchtone™ generator
U8,U9	HM3-6562-9 Harris 256x4 CMOS RAM
U10	LM396 audio power amp
U11	two-input AND gate (see text)
Y1	3.58 MHz color-burst crystal, HC18U case

Note:
Capacitors are either dipped tantalum, disc ceramic, or electrolytic, as noted. All resistors 1/4 watt, 5 percent tolerance.

A standard 9-volt transistor battery will power the dialer, including memory backup, for a long time, especially if alkaline batteries are used. An on/off switch is not necessary since standby battery drain, for other than the memory, is practically zero. (Battery drain increases to about 60-80 milliamps for the few seconds when tones are generated.) Replacing the battery is no problem. Because U8 and U9 will retain their contents down to 2.0 volts and use so little current, C18 can power the memory for ten or more minutes while changing batteries.

For those who desire to power the unit by a car or base station supply, **fig. 6** shows a suitable circuit that includes a backup battery for portable use. The backup battery should be at least 4.5 volts, to adequately power U7, and no more than 7.0 volts, to ensure automatic switch-over when the external supply is connected.

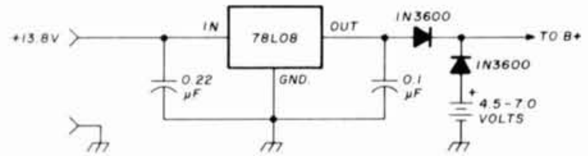


fig. 6. The auto-dialer can be powered by an external 13.8-volt supply if desired, using a battery as backup. Standard silicon rectifier diodes can be substituted for the IN3600's.

operation

Using the dialer is simple. R21 adjusts the tone output level and R19 the monitor volume. For manual operation, just key the dialer — PTT operation is automatic. To program, set S6 to the desired telephone number, switch S1 to PROGRAM, push S5 to reset the counter, and dial in your number just as if you were dialing manually. Program a carrier drop between your access code and telephone number if required by your repeater. You can also add a blank or two between the access code and number to allow time for obtaining a dial tone during dialing. After the last digit, add an END, unless, of course, you've programmed sixteen digits. (An eleven-digit long-distance telephone number, plus a three-digit access code, carrier drop and blank, will not need an END.) Switch back to the RUN mode and push S2 to dial the sequence just programmed. When the monitor volume becomes distorted, lower its volume slightly to restore clarity. When that doesn't work, it's time to change the battery.

manufacturers and component sources

Harris Semiconductor, Box 883, Melbourne, Florida 32901, (305) 724-7430

Mostek Corp., 1215 W. Crosby Road, Carrollton, Texas 75006, (214) 242-0444

Eeco, 1441 E. Chestnut Ave., Santa Ana, California 92701, (714) 835-6000

Cherry Electrical Products Corp., 3600 Sunset Ave., Waukegan, Illinois 60085, (312) 689-7700

Distributors of some of the harder-to-get chips:

Hamilton/Avnet (Harris): (516) 333-5800 (NY)
(714) 279-2421 (CA)

Schweber Electronics (Mostek): (516) 334-7474 (NY)
(714) 556-3880 (CA)

Tri-Tek Inc. (Mostek): (609) 995-9352 (AZ)

Spectronics Inc. (Mostek): (312) 848-6777 (IL)

ham radio

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modifications to the Heath model 10-4530 oscilloscope

Simple circuit revision eliminates the dc balance control in this popular instrument

My oscilloscope, built from a popular kit, is an ac-dc 10-MHz instrument that has given me good service for over five years. Specifically, it is a Heathkit model 10-4530. As in most other makes of oscilloscopes of this vintage, it has a balance control to zero the offset voltage of the input stage so that, with no input, the baseline does not move vertically when the gain control is varied. This oscilloscope's balance control is a small, single-turn trimmer mounted on the PC board. Unfortunately, to make an adjustment, the cabinet has to be removed, which doesn't offer much encouragement for keeping the offset voltage zeroed.

I tried replacing the single-turn trimmer with a ten-turn pot and also tried replacing the FETs, but the drift persisted. I was about to install a balance control pot somewhere on the front panel when it occurred to me that I might be able to design a better zeroing circuit. This article describes my solution.

the original circuit

To better understand the problem and my solution, the original zeroing circuit is shown in **fig. 1**. Basically, Q3 is a source follower, which presents a high impedance to the decade attenuator and a low impedance to the 1-2-5 attenuator. It draws about 4 mA and has a gain of about 0.8 at point **A** when the gain control is at its minimum position. Point **A** must be kept at precisely zero volts dc (with no signal input), otherwise any offset at this point will be passed on to the following attenuator as a variable offset as the gain control is varied. By adding a constant-current circuit consisting of Q4 and the dc balance control, an adjustable bucking current equal to the drain current of Q3 holds point **A** at zero potential, theoretically.

Practically, at least in my oscilloscope, point **A** would drift off zero. Temperature changes may have been partly the cause, since the FETs are not operated at their zero-temperature-coefficient currents. FET zero-temperature-coefficient currents are usually about one fourth the actual currents here. Reducing the current of Q3 to its zero-temperature-coefficient current would require adding a relatively large source resistor to develop the required gate bias of around − 1.3 volts. Adding such a source resistor would reduce the follower gain at point **A** to an unacceptable level.

the solution

Obviously what is needed is a voltage follower that has a zero voltage output at zero voltage input. After

By John T. Bailey, 86 Great Hills Road, Short Hills, New Jersey 07078

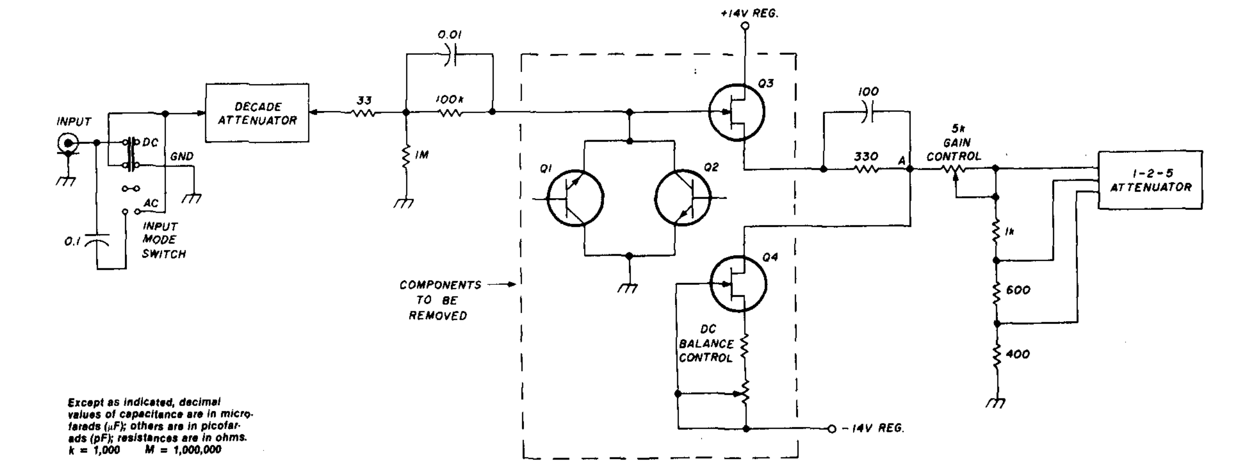

fig. 1. Original circuit of the input stage of the Heathkit model 10-4530. Point *A* should be maintained at zero dc potential with input grounded.

I'd considered automatic zeroing circuits, such as those used in digital voltmeters and other equally complex circuits, my junk box yielded the solution. It is the LM310. This IC is specifically designed for voltage-follower use. Typically, it has an input resistance of 10^{12} ohms, an input bias current of only 2 nA, very low output resistance, supply current of about 4 mA (the same as Q3's drain current — thus not disrupting the original supply circuits), a slew rate of 30V/μs, and a unity bandwidth of 20 MHz. It also has input protection, so Q1 and Q2 are not required. It has pins for offset nulling. Its gain is specified at 0.999. Note that the usual voltage follower connection from the output to the inverting input is not required, since this is accomplished internally in the LM310.

These specifications are ideal for this application with the exception of the input bias current of 2 nA which, if not bucked out, would cause a slight movement of the baseline when switching ranges or when grounding the input with the **AC-GND-DC** switch. This happens because 2 nA flowing through the 1-megohm gate resistor develops 2 mV across it. A 2-mV offset voltage would displace the CRT baseline 0.2 cm when using the 10 mV/cm range. This offset voltage isn't constant because the 1-megohm resistor is shunted by various resistors in the decade attenuator when ranges are switched, and it is shorted when the **AC-GND-DC** switch is used in the **GND** mode. Therefore, the drop across the 1-megohm resistor varies from zero to a maximum of 2 mV when the most sensitive range is used.

A simple bucking circuit cancels the adverse effect of the LM310 bias current. The bucking circuit, as shown in **fig. 2**, applies an opposing current through the 1-megohm resistor. While not completely canceling the offset voltage under all range positions, it reduces the offset to values ranging from zero to 8 μV. This is an insignificant offset that can't be observed on the CRT. **Fig. 2** shows the modified circuit using the LM310.

The original 1-megohm gate resistor has a tolerance of ± 1 percent, since it serves as the lower leg of the input divider when the X10 probe is used. Therefore, when a 22-megohm resistor is added in parallel, it becomes necessary to increase the 1-megohm resistor by 43k, so that the resulting effective input resistor is still 1 megohm. Resistor R6 accomplishes this.

construction

After removing the parts indicated in **fig. 1**, there is just enough room to install the new components. I used a 3/4 by 1 inch (19 by 25.4 mm) piece of perfboard to mount the LM310 with its socket, the R4 nulling pot, R5, C2, and C3. **Fig. 3** shows the component layout. Point-to-point wiring was used on the reverse side. Components R1, R2, R3, R6, and C1 were installed "free-standing." Connections from the five flea clips to the oscilloscope's PC board were made with short wires through holes left in the PC board where components were removed. R5 was needed to reduce the gain to match the lower original gain so that calibration could still be made within the range of the calibration pot in the following stage.

adjustments

Temporarily connect a 100-ohm pot in place of R1 and omit R2. Let the oscilloscope warm up for five or ten minutes. Then with the **AC-GND-DC** switch in the **GND** mode and the range switch in the 10 mV/cm position, adjust R4, the nulling pot, until the CRT

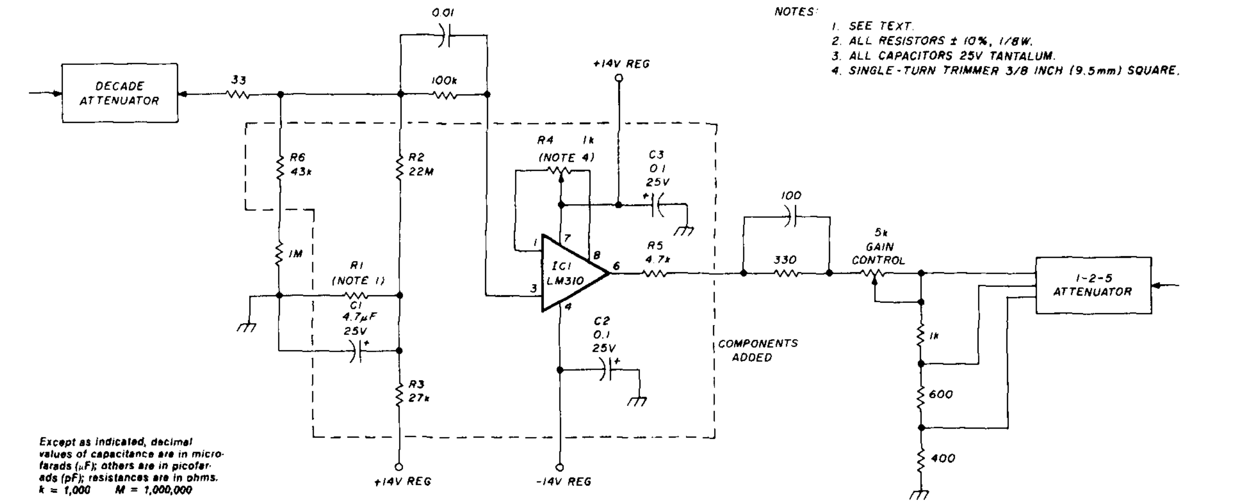

fig. 2. Modified circuit using an LM310 voltage follower. Pin 6 of the LM310 is maintained at zero potential with no input to the oscilloscope.

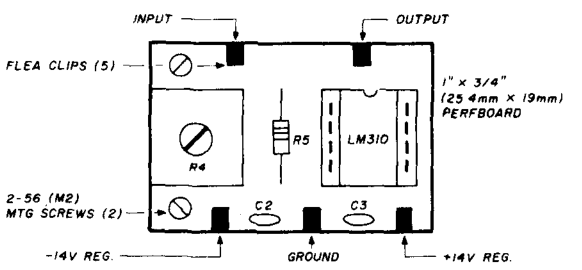

fig. 3. Component layout of the modified input circuit.

baseline does not move vertically as the gain control is varied from minimum to maximum. Next, install R2 and adjust the temporary pot so that the baseline doesn't jump when the **AC-GND-DC** switch is changed from **GND** to **DC**. Then measure the value of the temporary pot and install a resistor of the same value. The value required will depend on the tolerances of R2, R3 and the actual bias current of the particular LM310 used. The value isn't very critical. I found I needed a 62-ohm resistor but I used 56 ohms with excellent results.

additional comments

The Heathkit model 10-4530 has the same circuit at the input of its horizontal channel. This same modification could be used here also but I didn't make that change, principally because it looked rather hard to fit the new parts in the available space.

No attempt was made to minimize temperature effects in this modification. Actually, after a warmup period of five minutes no temperature-related drifts were observed in the room-temperature environment in which my oscilloscope is used.

The LM310 has been around for quite a few years and is readily available from mail order sources (James Electronics at $1.75 for example). Adding the cost of the other parts, the total comes to around $5, which is a very respectable expense for such an effective modification.

After having completed this modification I ran a frequency-response test on the oscilloscope and found it to be well within its specified range of 0 to 10 MHz ±3 dB.

This modified circuit has been in operation now for over six months with no drift, and no adjustments have been necessary.

other oscilloscopes

Owners of oscilloscopes with input-voltage-follower circuitry different from the Heathkit model 10-4530 can, with some study, probably adapt this same modification to their instruments. Typically the second stage will be a differential gain stage with provision for calibration and position adjustments. The first stage will be a voltage follower providing gain and dc balance adjustments as in the Heath oscilloscope. If such is the case in your oscilloscope, merely replace the first voltage follower stage with the LM310 circuit modification described in this article including the input bias current bucking network. Then connect a 5 k pot from LM310's pin 6 to ground with the arm going to the next stage. This provides variable gain with no offset.

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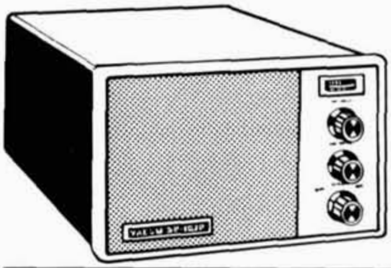

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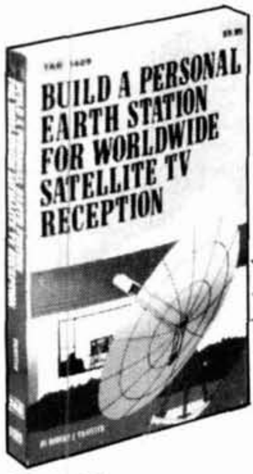

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More Details? CHECK—OFF Page 92

propagation of radio waves

A discussion of how radio waves travel through space

It's hard to visualize, but at this very instant there are electromagnetic fields all around you, at frequencies from virtually dc to gamma radiation, originating from sources as near as your desk lamp and as far away as distant galaxies. Some are manmade, others natural in origin. Even the energy from an Amateur Radio station in Japan, running perhaps less than 10 watts, may be passing through your body as you read this.

What are radio waves? How do they travel over the horizon? What affects their propagation?

electromagnetic radiation

Any electrically charged particle has an electric field surrounding it. A moving charged particle produces a magnetic field. But an accelerating charged particle — one whose speed is changing — produces

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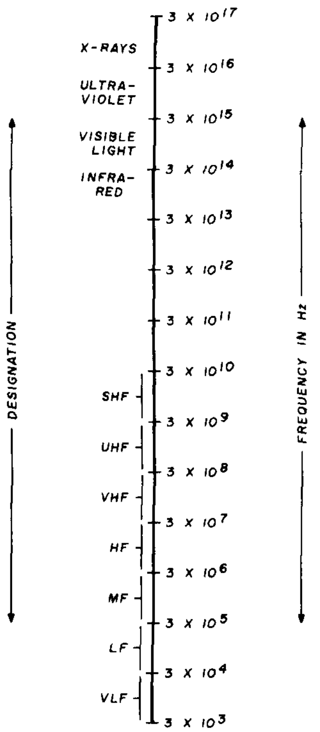

fig. 1. Logarithmic representation of the electromagnetic spectrum.

an electromagnetic field. This kind of field has a way of reproducing itself in such a way that, even at great distances, the electrons in a conductor are accelerated in a manner identical to that of the particles in the far-off antenna. Usually, when electromagnetic fields are produced deliberately for communications purposes, a sine-wave current is generated in a piece of wire. This current may have any frequency, from less than 1 Hz to billions of Hz.

the electromagnetic spectrum

Electromagnetic fields can have almost any frequency except zero. Radio and television signals have frequencies between about 10 kHz and several GHz. As the frequency is increased past the radio range, we get infrared, visible light, ultraviolet, and X-rays. **Fig. 1** shows a logarithmic diagram of the electromagnetic spectrum from 3 kHz to 3×10^{17} Hz (300 quadrillion Hz!).

Radio waves are categorized as VLF (very low frequency), MF (medium frequency), HF (high frequency), VHF (very high frequency), UHF (ultra high frequency), and SHF (super high frequency). **Fig. 1** shows where these designated ranges fall relative to the rest of the electromagnetic spectrum.

Radio waves, and all electromagnetic fields, tend to travel in straight lines. There are factors that bend radio waves, however, and it is fortunate that this is so. Otherwise, radio communications as we know it would be impossible. Let's look at the various ways that electromagnetic energy fields are affected by the environment. Then we'll examine how the effects change with changing frequency.

Radio waves can be bent by ground conduction, the ionosphere, and by tropospheric disturbances. These effects are usually referred to as ground-wave, sky-wave, and tropospheric propagation, respectively.

the ground wave

At some frequencies, signals tend to follow the earth for great distances. The ground actually forms a part of the circuit, acting like a wire and transferring energy. This kind of propagation occurs when the electric lines of force are vertically polarized, as shown by **fig. 2A**. Ground-wave propagation is best at low frequencies, and gets progressively less efficient at higher frequencies.

the sky wave

Sky-wave propagation is the familiar effect that permits us to listen to distant stations on the am broadcast band and on the shortwave bands. Ionized layers of the upper atmosphere cause the electromagnetic energy to be bent back down to the earth, which facilitates over-the-horizon communications. There are four different layers of ionization that affect radio energy: the D layer at a height of about 45 miles, the E layer at about 65 miles, the F1 layer at about 100 miles, and the F2 layer at about 130 to 260 miles. These layers fluctuate somewhat in altitude and thickness; they are illustrated in **fig. 2B**. The F1 and F2 layers usually merge into a single layer, the F2 layer, during the hours of darkness.

Ionospheric effects vary tremendously with frequency. We will look at these phenomena shortly.

tropospheric propagation

At certain wavelengths, the atmosphere itself can bend the path of an electromagnetic field. Sometimes this occurs as refraction, in which case it is called "tropospheric bending" (**fig. 2C**). Tropospheric bending tends to spread a beamed signal, as shown. Bending takes place near a frontal system, where cool, dry air is overlaid with warm, moist air.

Occasionally, the boundary between two air masses is so well defined that actual reflection occurs. This is called "ducting." Ducting may occur between the ground and the plane dividing two air masses, or it may occur between two air-mass boundaries (**fig. 2D**).

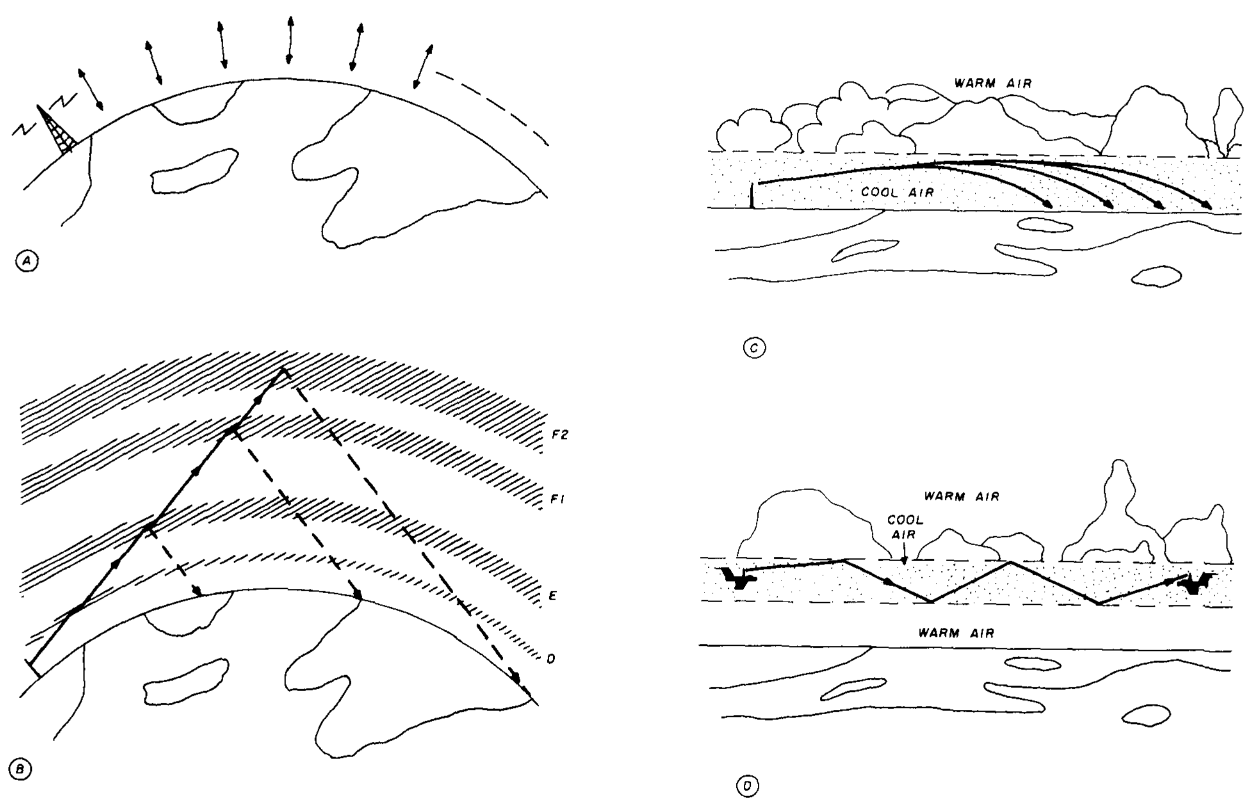

fig. 2. (A) Ground-wave propagation of vertically polarized waves; (B) sky-wave propagation; (C) tropospheric bending; and (D) ducting.

propagation at VLF and LF

Let us construct an imaginary transmitting station, and raise the frequency gradually while we investigate the effects of the ground, ionosphere, and troposphere. We'll start at 3 kHz, the low end of the VLF band, and progress into the UHF and SHF.

At VLF (3 to 30 kHz)* and LF (30 to 300 kHz), propagation occurs via ground wave and sky wave. There is no tropospheric bending or ducting.

In this frequency band, electromagnetic fields are "trapped" between the F2 layer and the earth, in much the same way as sound travels in a large room with a low ceiling. All energy reaching the F2 layer is returned to earth, except for a small loss to heating of the ions. The earth reflects signals back up into space. It's like a huge echo chamber.

At *certain times*, the D layer gets in the way of this, somewhat like the effect of a suspended cotton sheet midway between the floor and ceiling. The D layer absorbs energy, preventing it from bouncing back and forth indefinitely between the ground and the F2 layer. D-layer absorption is more severe during the daytime than at night, and increases toward the upper end of the VLF/LF range. During solar flares, the D layer may totally wipe out communications via sky wave at VLF and LF.

Ground-wave propagation is very good at VLF and LF. A vertically polarized signal can travel thousands of miles at VLF and hundreds of miles at LF, although high power and huge antennas are required. Since ground-wave propagation has nothing to do with the ionosphere, the VLF and LF bands may prove valuable on planets that don't have any ionosphere and hence no sky-wave propagation. Ground-wave signals do not fade; such a circuit is just about like a telephone hookup.

propagation at MF

The MF range extends from 300 kHz to 3 MHz. As we raise the frequency of our imaginary transmitter above 300 kHz, we find that ground-wave propagation gets less and less efficient. The earth, which acts as a good conductor at VLF and a fair conductor at LF, begins to get lossy at MF. By the time we reach 3 MHz, the ground wave dies out after it has traveled only about 100 to 150 miles.

*Some sources say VLF is 3 to 30 kHz, others say 10 to 30 kHz.

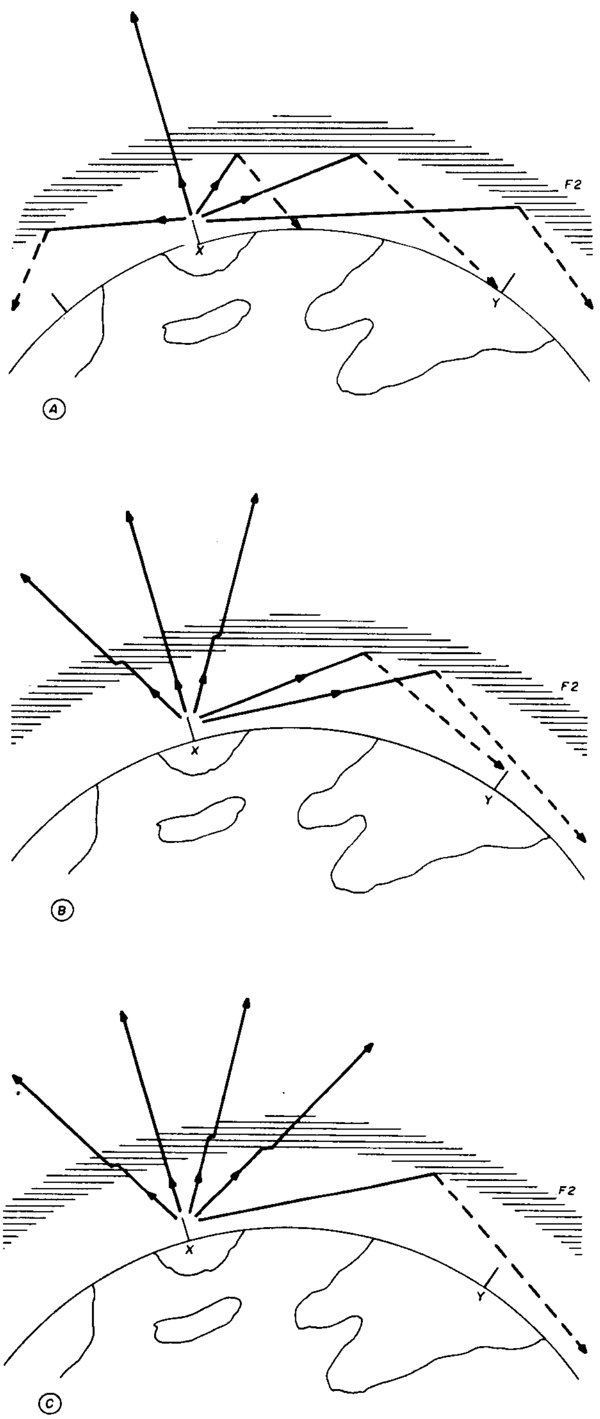

fig. 3. (A) critical frequency; (B and C) as frequency rises, more energy escapes into space.

Sky-wave propagation, however, continues. The F2 layer returns all signals in the MF range, provided the D layer does not interfere. But the D layer absorbs MF signals with relentless efficiency during the daytime. Consequently, the range is limited until the sun goes down. Then things get interesting!

Once dusk falls, the D layer quickly disappears, because at that altitude the atoms don't remain ionized unless they are constantly bombarded by ultraviolet light. The MF signals then reach the F2 layer, and worldwide communications become possible. As we get up towards 3 MHz, propagation gets better at night. The size of an efficient transmitting antenna is reasonable in the MF range, so it is no longer necessary to run hundreds of kilowatts to get long-range reliability.

At MF, there is still no tropospheric effect. The radio waves ignore the atmosphere completely.

propagation at HF

The HF band is the range of frequencies generally called "short waves." At 3 MHz, all signals that reach the F2 layer are returned to the earth. But as we climb in frequency, a point will be reached where not all signals come back. Signals sent straight up will be the first to escape into space. At a frequency called the "critical frequency," signals sent vertically upward will not return, but all others of lower frequency will (**fig. 3A**).

The critical frequency may be as low as 4 or 5 MHz or as high as 8 to 10 MHz, depending on the density of the F2 layer. In general, the greater the density, the higher the critical frequency. F2 density is a function of the level of solar activity. This varies from day to day, but in general it follows a cycle lasting about eleven years from peak to peak. We are just passing a sunspot maximum now, and will reach another peak in about 1991. The next minimum will come in 1986 or 1987.

As we continue up from the critical frequency, energy at lower and lower angles will escape into space (**figs. 3B** and **3C**). Also, as we raise the frequency, the ground wave gets more and more anemic until, at 10 MHz, it extends hardly past the visual horizon. Above 10 MHz there is no ground wave for all practical purposes.

In **fig. 3C**, communications between points X and Y is impossible. The sky wave does not come back to the earth until well beyond point Y; within this limit, the angle of incidence at the F2 layer is too large. The ground wave dies out long before it reaches point Y. Viewing this situation from above (**fig. 4**), we see that there is a zone where signals from X cannot be heard. The inner dotted area represents the range of the ground wave, and the cross-hatched area represents the region where the sky wave is returned to earth. The quiet zone is called the "skip zone" because signals skip over it.

As we raise the frequency still more, the skip zone gets wider and wider until finally no signals are re-

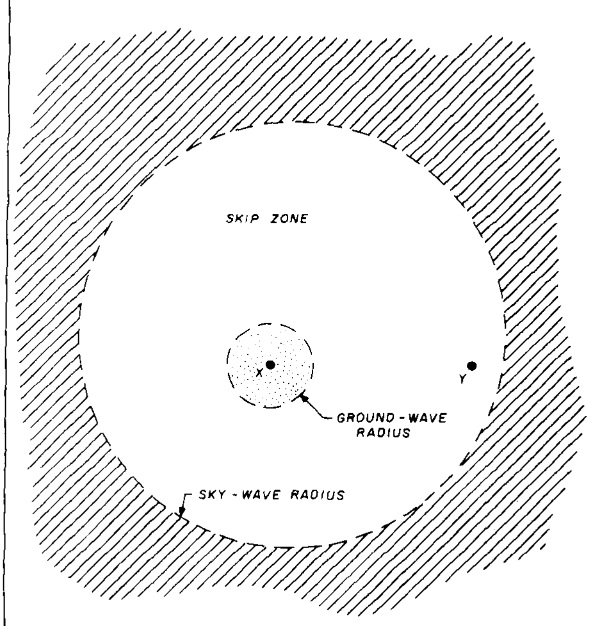

fig. 4. The skip zone, viewed from above.

turned to earth via the F2 layer. We have reached the highest frequency at which F2 communications is possible. Like the critical frequency, this frequency depends on the amount of ionization in the F2 layer. The "maximum usable frequency," as this is called, may be as low as 7 or 8 MHz on a winter night during a sunspot minimum; on a few occasions it has been as high as 70 MHz.*

As we get into the upper HF range, D-layer absorption decreases to the point of insignificance. The troposphere begins to have some effect on radio waves. Occasionally, at the upper end of the HF band, "patches" of high-density E-layer ionization allow communications up to several hundred miles. This is called "sporadic E" propagation. It usually occurs during short periods of exceptionally high solar activity.

propagation at VHF and above

As we progress higher in frequency, F2-layer propagation gets less common until, above about 70 MHz, it never happens. However, sporadic-E is possible up to 120 or 140 MHz, and openings via this mode are frequent if short-lived. There is no D-layer absorption at VHF and above, so daytime communications are just as good as at night.

At VHF, the effect of the troposphere is very important in long-distance communications. When a warm air mass overruns a cool one (warm front) or a cool air mass pushes underneath a warm one (cold front), tropospheric bending usually occurs. Cool air, being denser, has a higher index of refraction for VHF energy. This bends the waves back down toward the earth as shown in **fig. 2C**. (Sound waves over a still lake behave in a similar way. This is why you can sometimes hear people talking thousands of feet away on the lakefront.)

Tropospheric bending can take place over ranges exceeding 1000 miles. The best conditions between two points for "tropo" are near a frontal system forming an approximately straight line passing on the same side of both points, and so that both points are within the cool air region. Tropo is common over large bodies of water, which cool the air near the surface during the daytime.

The other, and less common, form of tropospheric propagation is known as "ducting." When a cool air mass is sandwiched in between two warm ones, or when the boundary is very sharp between two air masses, reflection takes place at the boundary. For communications to be possible via a duct, both the receiving and transmitting antenna must be within the duct, and the duct must exist at all points between the two antennas. In **fig. 2D**, two airplanes can communicate over the horizon because there is a duct between them.

Bending and ducting are possible well into the UHF region — exceeding 1 GHz. As we raise the frequency ever higher, dust particles and water droplets begin to have an attenuating effect. Eventually, even the air itself degrades propagation. At some frequencies we will find the atmosphere almost opaque because of absorption. If we keep going higher, we finally reach the infrared, visible light, ultraviolet, and X rays (**fig. 1**).

exotic forms of propagation

We have traversed from 3 kHz, a frequency so low that connecting headphones directly to the antenna may yield an audible tone, to trillions of Hz, where the wavelength is microscopic. Over this entire range, the common forms of over-the-horizon propagation are ground-wave, sky-wave, and tropospheric. But long-distance communications can be accomplished by other means, more unusual but still significant and useful. These strange effects include aurora, meteor scatter, moonbounce, and subterranean propagation.

Aurora. Aurora is caused by intense solar disturbances. An auroral display is usually accompanied by total disruption at HF and below because of absorption by the D layer. Above about 20 to 30 MHz, however, signals can be reflected off auroral curtains. If

*The precise definition of maximum usable frequency varies. It may be defined based on two specific points on the globe, such as X and Y, or it may be defined independently of the receiving point, as it is here.

two stations both point their antennas at the same part of the aurora, they can communicate. This is shown in **fig. 5A**.

Auroral communications is accompanied by rapid fading of extraordinary proportions. The motion of the aurora causes a severe Doppler effect, spreading the signal out over as much as several hundred Hz. Multipath propagation (illustrated by the dotted and solid lines) can cause fading so rapid that voice-modulated signals sound as if the other person is speaking through an electric fan. A CW carrier, though readable, may sound like a warbling hiss.

Of course, both stations must be at latitudes high enough to take advantage of auroral effects.

Meteor scatter. When a meteor enters the upper atmosphere, it leaves an ionized trail. At VHF, two stations whose antennas are both aimed at this trail may communicate for several seconds. When there is a meteor shower, usable trails may exist for a large enough proportion of the time so that a conversation may be carried on. Meteor scatter is also accompanied by multipath effects (**fig. 5B**).

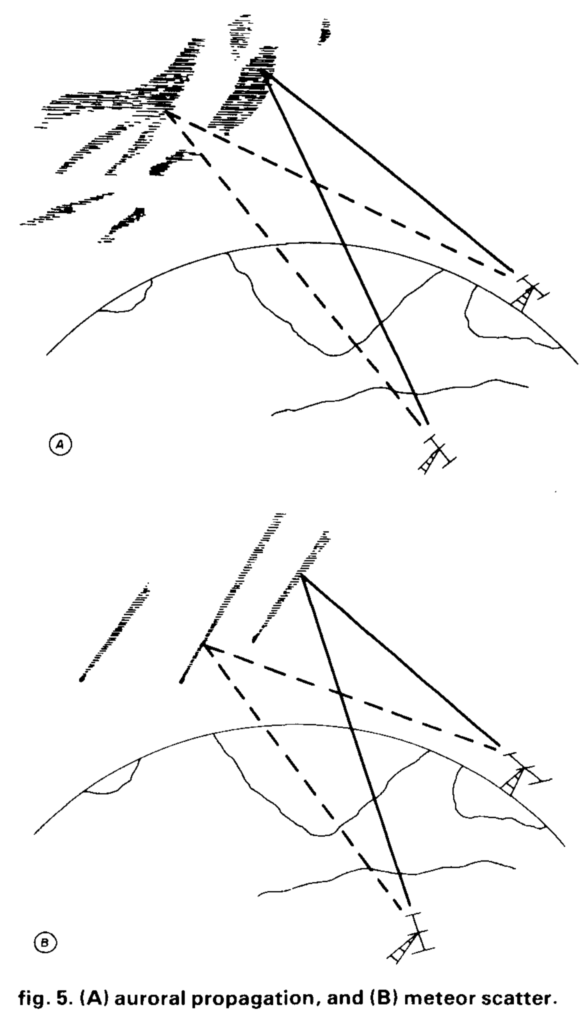

fig. 5. (A) auroral propagation, and (B) meteor scatter.

Moonbounce. Does this sound like something that requires a radio telescope and hundreds of kilowatts? Well, it has been done by Radio Amateurs with only 1000 watts and relatively modest antenna systems. Moonbounce is possible at any frequency that will get through the ionosphere, but VHF and UHF are the most commonly used frequencies for this mode, since it is easy to construct antennas with high gain for those frequencies.

Some Radio Amateurs have clock-driven, equatorial-mount antenna arrays so they can communicate via moonbounce for hours at a time.

Subterranean propagation. This is perhaps the strangest mode of all. The entire planet, being finite in size and a fairly good conductor at low frequencies, has a resonant frequency at which alternating currents bounce around inside the globe and reinforce each other. The military is already experimenting with subterranean propagation for the purpose of communicating with submarines. Subterranean propagation requires huge antenna systems (if you can really call them "antennas") and a lot of power. It is not something for the backyard experimenter!

conclusion

Would you expect to hear a Middle Eastern broadcast station on 9.6 MHz at 10:00 AM EST in New York? How about a Radio Amateur from Australia at 6:00 PM on 21 MHz? Would you expect to hear "skip" (a misnomer) on CB in the middle of the night in 1986? You should be able to answer these questions for yourself, based on the information here. You will be less likely to waste time listening for stations whose signals aren't getting to you, once you understand the propagation characteristics of the particular band.

Of course, there are exceptions to the rules in any game, and Mother Nature's game often takes time out. I have contacted a ham in the USSR from Miami on 7 MHz at high noon local time, while running just 100 watts from my modest station. Sometimes you'll hear AM broadcast stations from hundreds of miles away during the daytime, or signals that should be in the skip zone may come in S9 plus. I'm glad the old lady is a little eccentric.

bibliography

Reference Data for Radio Engineers, Howard W. Sams & Co., Inc., 1975, Chapter 28.

The ARRL Antenna Book, American Radio Relay League, Inc., Newington, Connecticut, 1977.

The Radio Amateur's Handbook, American Radio Relay League, Inc., Newington, Connecticut, 1981.

ham radio

biasing Class-A bipolar transistor amplifiers

Simplified approach to transistor biasing including a sample problem using load lines

The common-emitter amplifier is one of the most familiar circuits in use, but the procedure for biasing the amplifier for Class-A operation is not so well known. Over the past few years I have condensed what I've learned in the classroom and hamshack into the simple six-step procedure described in this article. I've found this procedure to be faster than cut and try methods and more tolerant of circuit parameter changes (such as temperature, power-supply voltage and transistor replacement). The procedure is based on several good engineering guidelines, yet it requires no mathematics more complicated than long division. It is ideal for Amateur projects.

I use the circuit of **fig. 1**. The transistor is operated as a Class-A amplifier in the common-emitter configuration. Resistors *R1*, *R2*, *R3*, and *R4* establish the dc operating point (bias) for the transistor. The capacitor does not affect the biasing and will be discussed separately. The task at hand is to select values for the four resistors based on the transistor type, power-supply voltage and collector current. **Table 1** lists transistor circuit parameters used in the following discussion.

biasing procedure

1. Choose the transistor type, power supply voltage and collector current. I usually select a transistor from my junkbox that can operate at the desired frequency and power level. Look up or measure the β of your transistor. Some reference manuals will list the h_{fe}, which is close enough to β for our purposes. If you're not able to calculate the collector current that you require, use something between 1 and 20 mA. You will probably get by. The 2N2222A, having a β of about 200, drawing 10 mA from a 13.8-volt supply, is a typical choice that will operate into the MHz region.

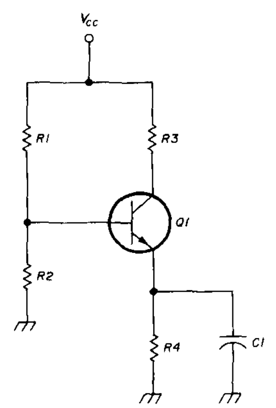

fig. 1. Circuit used for calculating transistor bias parameters as discussed in the text.

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table 1. Transistor circuit parameters.

parameter	definition
β	Large-signal current gain of a common emitter transistor.
h_{fe}	Small-signal current gain. In this article, β and h_{fe} are considered to be approximately equal.
I_b	Current flowing into the base terminal.
I_c	Current flowing into the collector terminal.
I_e	Current flowing out of the emitter terminal (in this article).
I_{r2}	Current flowing through R2.
V_b	Voltage measured from the base terminal to ground.
V_{be}	Voltage measured between the base terminal and the emitter.
V_{cc}	Power supply voltage (in this article).
V_{ce}	Voltage measured between the collector terminal and the emitter.

2. Calculate $R3 = (V_{cc} - 3.5)/(2I_c)$.

3. Calculate $R4 = 3.5/I_c$.

4. Calculate $I_{r2} = 5I_c/\beta$. This current is required to perform the following calculations.

5. Calculate $R2 = (I_c R4 + 0.7)/I_{r2}$.

6. Calculate $R1 = (V_{cc} - 0.7 - I_c R4)/(I_{r2} + I_c/\beta)$.

theory

The bias network must be designed so that the amplifier will operate over a wide range of temperatures and power-supply voltages, and tolerate replacement of the transistor. Mobile equipment, in particular, is subject to environmental extremes. It is not uncommon to encounter variations in β of 2:1 or more between different transistors of the same type. The circuit of **fig. 1** was chosen because it addresses all of these problems.

Stability considerations[1] suggest that $I_e R4$ be greater than or equal to $5V_{be}$, and I_{r2} be greater than or equal to $5I_b$. Since V_{be} for a silicon transistor will be about 0.7 volt, $I_e R4$ will need to be at least 3.5 volts to meet the first consideration. This should be the potential measured at the transistor's emitter terminal. Note that I_c is approximately equal to I_e. This allows the substitution of I_c for I_e in the first stability consideration and the resultant calculation of $R4$.

The remainder of the power-supply potential (that which does not appear across $R4$) is equally divided across the transistor's CE terminals and $R3$. This is sufficient information to calculate $R3$.

The value of I_{r2} is calculated to meet the second stability consideration. The required value of I_b will be I_c/β if the transistor's leakage current is neglected. $R2$ is calculated as soon as the potential at the transistor's base terminal, $I_c R4 + 0.7$, is determined. Finally $R1$ is calculated to pass $I_{r2} + I_b$ across a voltage drop of $V_{cc} - V_b$.

selecting the capacitor

The capacitor is not a conductor of dc and was neglected during the biasing calculations. However it plays an important role in determining the low-frequency response of the amplifier. The capacitor must be selected to present a low impedance path to ground from the emitter terminal at the lowest frequency of interest. The procedure to derive the exact capacitance required is beyond the means of many hams because it involves a transistor parameter not generally available in Amateur references. I have had some success choosing a capacitor whose reactance at the lowest frequency of interest is one tenth the resistance value of $R4$.

an alternative method: using a load line

The transistor's common-emitter collector characteristics, when available, may be used to construct a popular aid known as the load line.[2] The load line is a graphical device used to select the collector current, I_c, and load resistance, $R3$, that maximizes the amplifier's signal-handling ability. This suggests that the load line is most useful when the magnitude of the output signal becomes a significant portion of V_{cc}, and its use is probably a waste of time at low levels. Use of the load line replaces steps 1 and 2 of the procedure described earlier and yields calculated values of I_c and $R3$ as opposed to $R3$ alone. The calculation of I_c is the source of improvement.

Fig. 2 illustrates a typical set of curves for a transistor in the common-emitter configuration. Their

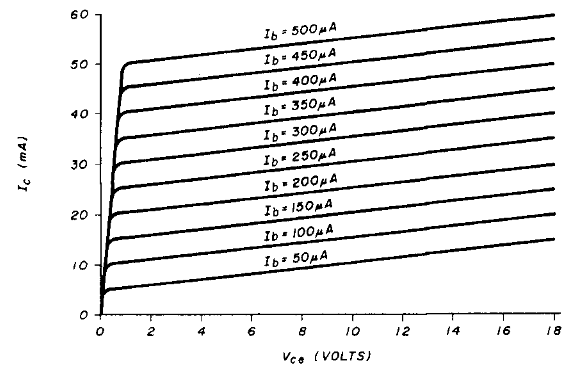


fig. 2. Collector current, I_c, as a function of collector-to-emitter voltage, V_{ce}, with base current, I_b, as a parameter in the common-emitter configuration.

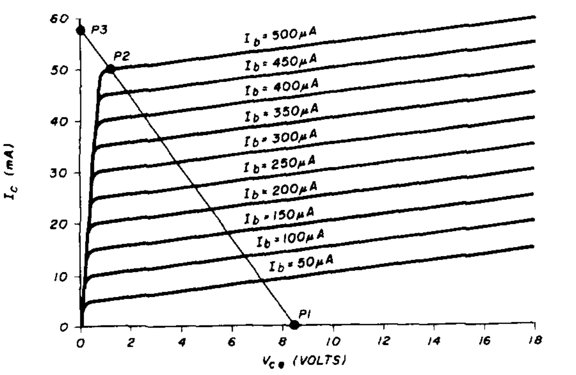


fig. 3. Biasing procedure using load lines, showing method of locating points P1, P2, and P3 as described in the sample problem.

examination reveals that the collector current, I_c, is being plotted against the collector-emitter voltage, V_{ce}, at various base currents, I_b. Actual common emitter characteristics vary from transistor to transistor of the same type and exhibit a marked shift with temperature; thus they are approximate.

Recall that the biasing procedure will develop 3.5 volts across *R4*, placing the emitter 3.5 volts above ground. This establishes the maximum collector-emitter voltage, V_{ce} *max*, as $V_{cc} - 3.5$ *volts*. Plot this point, *P1*, on the abscissa as shown in **fig. 3**.

Plot a second point, *P2*, just to the right of the knee of one curve. The higher the point is placed on the chart, the higher will be the collector current, signal-handling ability and dissipation. The exact position of the point is your design decision. The point in **fig. 3** has been positioned for maximum signal-handling ability. The collector current at P2 is the expected peak value under maximum signal conditions. Distortion may result if P2 is placed on the knee, because this is the region where the transistor begins to saturate.

Draw the load line from P1, through P2, to the ordinate. Plot point P3 at the intersection of the load line and the ordinate as illustrated in **fig. 3**. P3 is a construction point that will be used in the calculation of *R3*.

Plot point P4 at the intersection of the load line and the bottom curve as shown in **fig. 4**. The collector current at P4 is the expected minimum value under maximum signal conditions. Zero is not used, as unwanted distortion would result from the transistor approaching cutoff.

Plot point P5 midway on the loadline between P2 and P4. The collector current at P5 is the expected idling current under no-signal conditions. The idling collector voltage will be 3.5 volts (developed across *R4*) plus V_{ce} at P5.

Calculate:

$$I_c = I_{P5}$$

$$R3 = (V_{cc} - 3.5)/I_{P3}$$

where: I_{P5} is the collector current at P5 and I_{P3} is the collector current at P3.

These are the calculated values for I_c and *R3*, which will permit the amplifier to deliver its largest signal while remaining in the Class-A mode of operation.

Calculate the remaining resistor values by following steps 3 through 6 of the biasing procedure.

sample problem

The loadline of **fig. 4** is constructed for a hypothetical transistor operating with $V_{cc} = 12$ *volts*. P1 through P5 are plotted as described earlier.

The operating point, P5, suggests that the transistor's collector current, I_c, be set at 30 mA for maximum signal-handling ability. V_{ce} will then be 4.25 volts. The product of these two numbers indicates that the average dissipation will be 128 mW. β may be approximated by dividing the collector current at P5 by the base current. This transistor has a β of about 110. *R3* is calculated to be *8.5/0.058*, or about 150 ohms.

If the load line had not been used, I would have chosen $I_c = 10$ *mA* and calculated *R3* to be 425 ohms. The resulting amplifier would certainly operate, but without the signal handling ability of the load-line design. While this may not be important in an early stage of a speech amplifier, it surely would be in a Class-A driver for a higher-power stage.

The remaining resistors and I_{r2} are calculated as follows:

$$R4 = (3.5)/(0.03) = 116.7 \text{ ohms (use 120 ohms)}$$

$$I_{r2} = (5)(0.03)/(110) = 1.36\,mA$$

$$R2 = [(0.03)(120) + 0.7]/(0.00136) = 3161.8 \text{ ohms (use 3000 ohms)}$$

$$R1 = [12 - 0.7 - (0.03)(120)]/(0.00136 + 0.03/110) = 4716 \text{ ohms (use 4700 ohms)}$$

The resulting amplifier will be characterized by low impedances and high currents, dissipation, and signal-handling ability.

drawbacks and limitations

Nothing has been said about gain or input impedance. The entire procedure was developed on the basis that you must take what you can get. While this is satisfactory for simple projects, a more demanding application might employ feedback to stabilize the amplifier.[3]

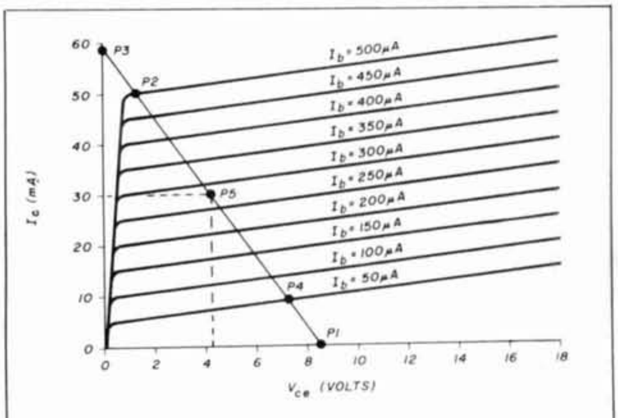


fig. 4. Point P4 locates the minimum collector current, I_c, under maximum signal conditions. Point P5 locates expected idling current under no-signal conditions.

In the procedure I assume the power supply will be able to deliver several times the emitter voltage of 3.5 volts, and everything is meaningless if this is not true.

Some older transistors having a low β, and germanium transistors require considerations which were not addressed.

The stability considerations involve a number of trade-offs. A more exact procedure might deliver better performance for a well-defined operating environment. Such a procedure is given in a step-by-step fashion in reference 1.

The loadline technique fails to take into account the input resistance of the following stage.

The loadline technique treats $R4$ as a voltage source, which reduces the effectiveness of the design when I_c drifts from its design point. However, this is not considered to be important in Amateur work.

Common emitter characteristic curves are not found in every semiconductor guide. Reference 4 is one guide that does include them for many transistors.

conclusion

I have presented a simplified approach to the often mysterious subject of transistor biasing. A number of assumptions were made to develop that simplicity, but I feel that the method described here is better than none at all.

references

1. General Electric Company, *Transistor Manual*, Seventh Edition, 1964, Chapter 4.
2. Millman and Halkias, *Integrated Electronics: Analog and Digital Circuits and Systems*, McGraw-Hill, 1972, Chapter 5.
3. ARRL, *Solid State Design for the Radio Amateur*, 1977, pages 19-22.
4. General Electric, *Semiconductor Data Handbook*, 2nd Edition, 1973.

ham radio

an expandable
microwave network
for multimode communications

Basic concepts for future development of a nationwide communications system

The projected network described in this article was originally conceived with the purpose of interlinking communities and cities on a broadband basis. Numerous other capabilities, however, were soon visualized and included to permit almost direct compatibility with future expansions. The resultant communications network is a highly flexible system that may be implemented between adjoining communities, with additional networks in other areas interlinked as desired. Communications modes that can be handled by the network are almost unlimited.

network philosophy

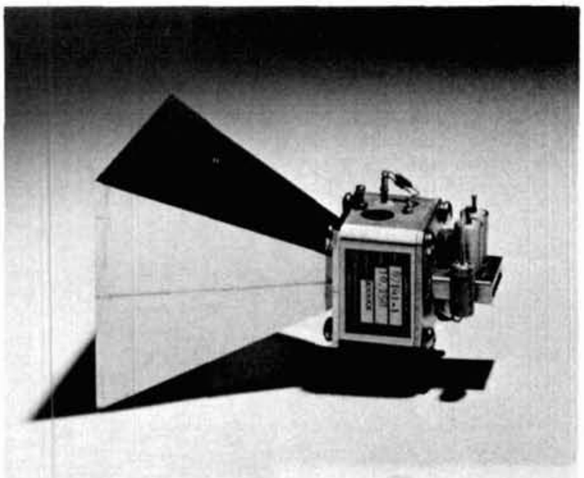
A basic outline of the microwave network is shown in **fig. 1**. The primary purpose of the network is to provide emergency communications between areas, or cities, separated by a distance greater than the normal 2-meter communications range. Secondary communications capabilities should be considered at installation time, however, since path losses and over-all network bandwidth are directly related. The number of "dumb," or passive, microwave repeaters will be determined by distance and terrain between associated cities, each accepting responsibility for its own part of the link. Existing 2-meter repeater groups and councils can provide finances and frequency/code coordination, respectively.

Two transceivers are shown connected to each microwave port, one preset on the primary frequency and the other scanning a range of approximately 1-MHz of the 2-meter band. (Exception: all secondary transceivers realize primary-frequency lockout). Secondary transceivers are under microprocessor control, permitting frequency scanning, spread-spectrum operation, and tone control of transceiver functions (enable/disable, lockout, connect to mailbox, and so forth). The network could initially develop between any two agreeing areas (each preferably with at least two local 2-meter repeaters, as this would confine costs of microwave link additions).

Additional areas could join the existing network by financing their part of the system while extending their benefits to existing network users. Assuming a similar network is also implemented in other areas, more systems may grow until an overall network merger is warranted and implemented. Additional networks may, likewise, grow and merge with the existing system as desired. Further expansions may include spurs and subnetworks as desired.

satellite interlinking

Continuing the network a step further, interlinking with the OSCAR Phase IV geostationary satellites could provide full-hemisphere to complete-world coverage for compatible mode users (projected data 1986). The outline for this concept is shown in **fig. 2**. OSCAR Phase IV is slated to include several features applicable for data communications. Some of these features are dedicated channels, tone controlling, and mailboxing. In some instances, a microwave net-



The 10-GHz Gunnplexer features bandwidths in excess of 20 MHz and direct adaptability to multi-unit linking. Transmitting frequencies of communicating units are offset by the amount of the desired i-f.

By Dave Ingram, K4TWJ, Eastwood Village No. 1201 South, Route 11, Box 499, Birmingham, Alabama 35210

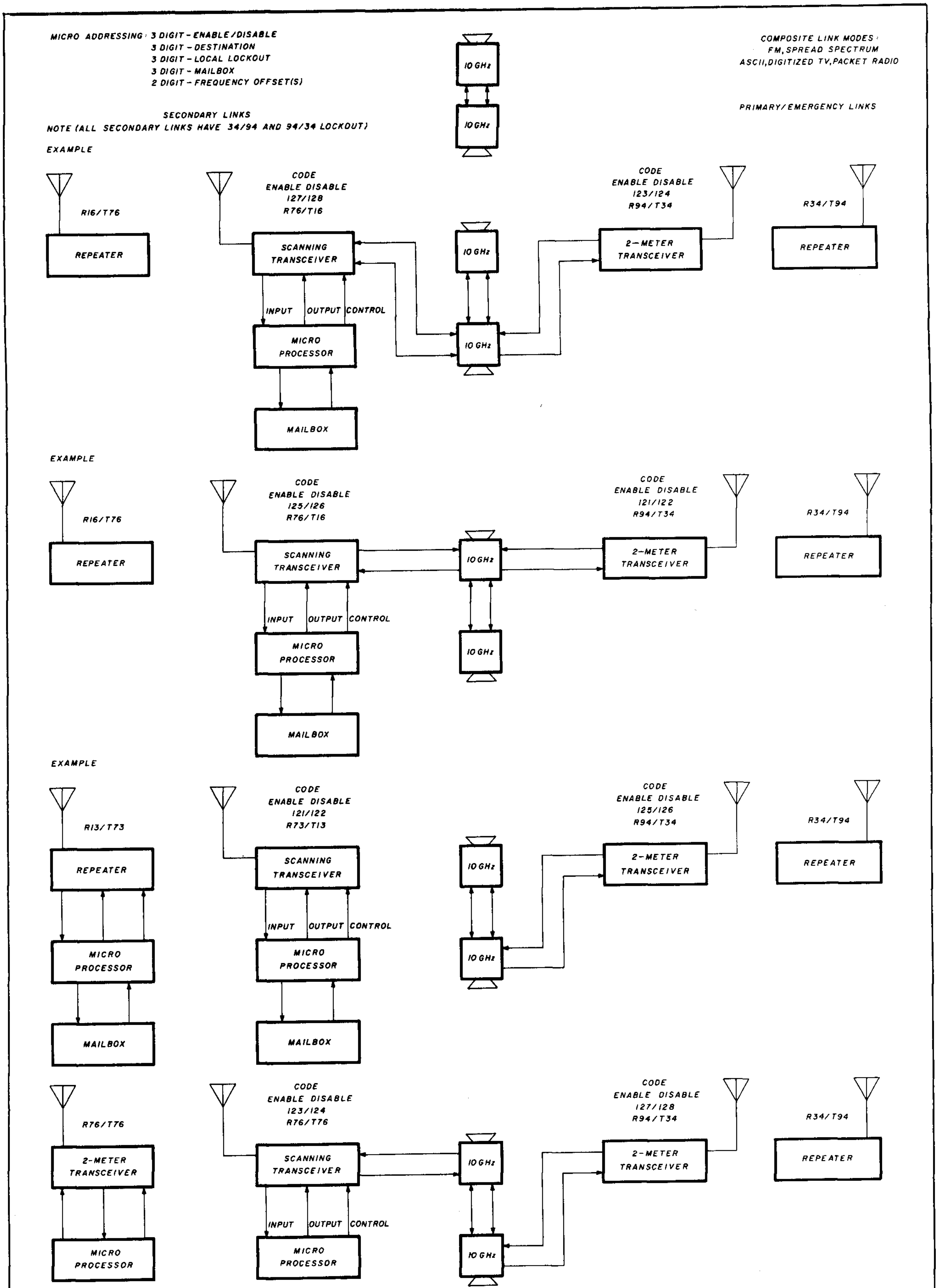


fig. 1. Suggested national microwave network for providing emergency communications between areas separated by a distance greater than normal 2-meter coverage.

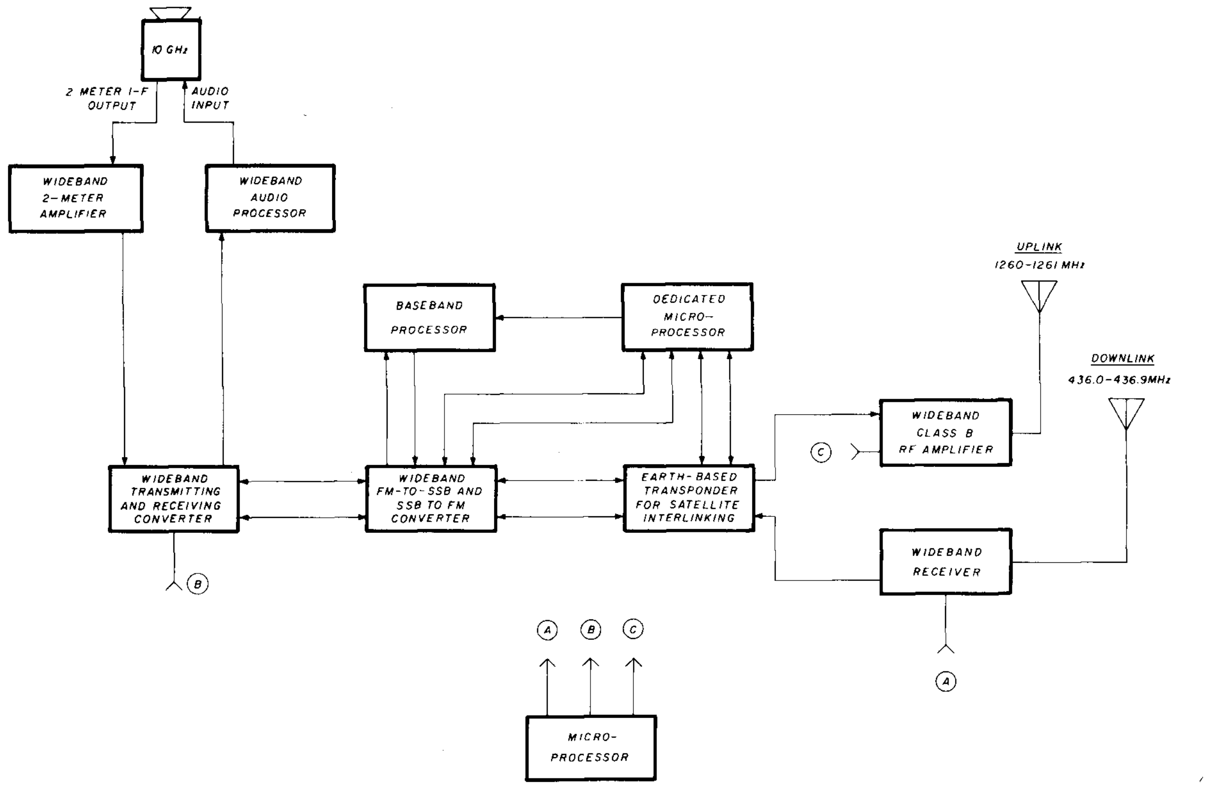


fig. 2. OSCAR Phase IV interlink for a national microwave network. Compatibility is ascribed to PLL-SSB concepts. Master microprocessor monitors "control frequency" of 2 meters and activity of 2-meter bandpass to enable satellite link if a pre-established count of signals on the downlink, uplink, and 2-meter bandpass are not exceeded. If justified, proper follow-up sequence of 2-meter control signals will access the satellite link.

work port may interface with an OSCAR earth-based transponder. At other times, a separate network-to-satellite earth-based station will be required. The criteria will, naturally, be determined by geographic locations of microwave links.

OSCAR satellites necessarily use narrowband modes such as SSB or CW; however, a microwave network should use a constant-carrier mode such as fm. The key to compatibility between these modes is constant-amplitude single sideband, or merely PLL-SSB. This concept, which was developed in Europe four or five years ago, employs a variable amplitude in the normally suppressed carrier. Carrier amplitude is miniscule during modulation, but increases to full power during breaks of speech (after passing through the microwave network, the carrier may be fully removed, resulting in conventional SSB). Finally, total microprocessor control is employed for the link, its preprogrammed functions being available for call-up by coded tones.

technical aspects

The concepts associated with microwave links are, in several respects, unlike those employed in conventional VHF repeater links. Bandwidths of microwave systems, for example, are typically 0.5 to 4 MHz. Output power levels are noticeably lower, with large parabolic dishes providing signal gain capabilities. Conventional superheterodyne techniques are also altered: each microwave transmitter runs continuously, with a small portion of its output power being directed to its receiver's front end to provide a local-oscillator signal. Transmit frequencies of communicating units are then offset by a difference equal to the desired i-f (center frequency). This arrangement may be visualized with the aid of **fig. 3**.

All microwave units are originally transmitting on their hypothetical resting frequency. An incoming signal on 146 MHz shifts the transmitting unit 146 MHz. (A second signal on 146.50 MHz and a third signal on 146.80 MHz would appear as subcarriers of the original signal, until the 146-MHz signal disappeared. The 146.80-MHz signal would then be a subcarrier of the 146.50-MHz signal.) Assuming a "dumb" relay is required between ports, it would receive the 2.246-GHz signal, convert it to 146 MHz, amplify it, and apply it to the associated transmitter. The 2.246-GHz signal would then be received at the

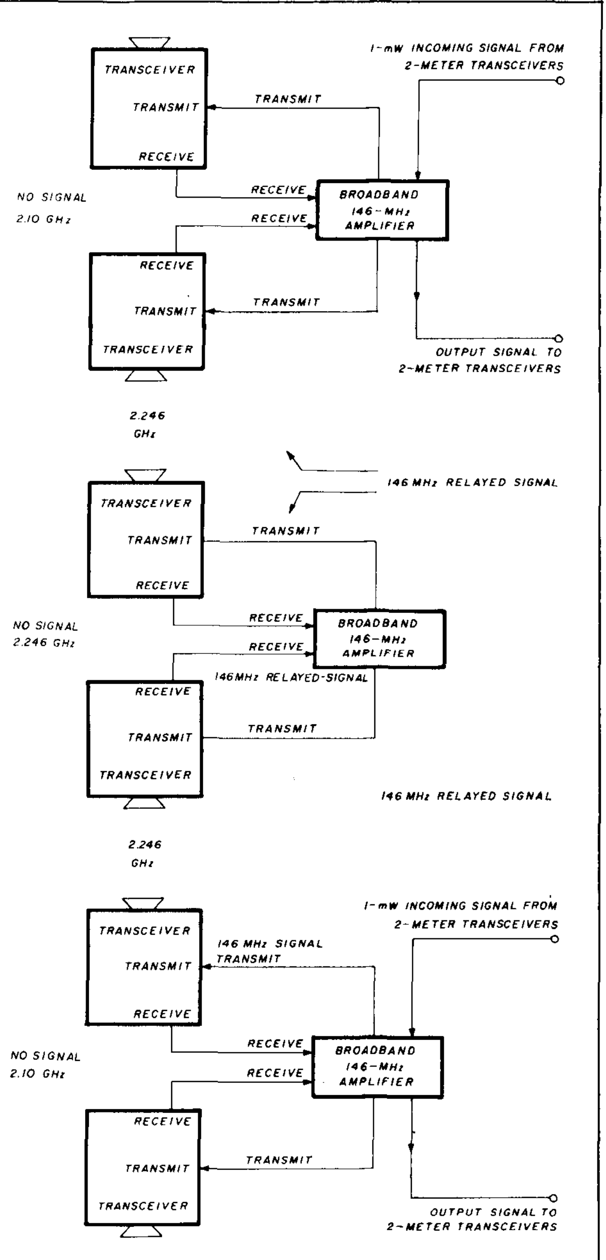


fig. 3. Operational concepts of the national microwave network. Middle unit is considered a "dumb," or passive, repeater with intelligent ports located in large cities.

subsequent microwave port, converted to 146 MHz and applied to a broadband amplifier. That i-f amplifier's output would feed the next 2.10-GHz transmitter and the 146-MHz transceiver (while also accepting 146-MHz band input signals from the 146-MHz transceiver). The microwave system's overall bandwidth could easily expand to 1 MHz, as necessary, with all data/tones being moved in a conventional manner. All operations and frequency determinations of network-located 2-meter transceivers are under microprocessor control. This means that port-available signals may be selected or rejected by tone control, as desired. Preprogramming of the microprocessor establishes basic network standards.

Two microwave bands are prime candidates for network links: 2.1 GHz and 10 GHz. Gunnplexers are readily available for 10-GHz systems; however, their individual-link range is limited.*

operation

Referring to **fig. 1** and applying previously acquired knowledge, a brief discussion of systems operation is presented.

Assume an Amateur operating on 146.76 MHz desires to contact a distant repeater on 146.76 MHz. A 146.76-MHz signal with PL capability and tones of 1, 2, 3 are used for connecting the scanning transceiver into the network. Notice the distant 146.94-MHz transceiver employs lockout, which prevents accidental access. Another three-digit code (1, 2, 7) brings up the desired distant 146.76-MHz scanning transceiver, with subsequent microprocessor control establishing operating parameters for processing that area's 146.76-MHz repeater. Assuming the distant Amateur desires disconnection from the link (or the calling station desires distant disconnection), another three-digit code will bring down that transceiver (example: 1, 2, 8). Data packets may be moved either to the distant repeater or left in the electronic mailbox as required.

Continuing overall system capabilities one step further, we can use tone control and port-located microprocessors for handling frequency offsets and spread-spectrum hopping sequences. This capability would permit an individual Amateur operating on 146.52 MHz to catch the network's scanning transceiver, establish different network-relayed frequencies, and proceed in the previously described manner (example: 146.52/146.52 MHz into the network; 146.16 MHz out of the network. One or two fully microprocessor-controlled transceivers are required for this option.)

A full description of the network would, obviously, encompass numerous pages of discussion. I thus leave those operations open for your imagination and thoughts of expansion. The network outlined is a coarse system for future communications techniques. I hope this first basic step will inspire future developments.

ham radio

*Similar units for operation on 2.1 GHz will soon be available from Universal Communications, P.O. Box 339, Arlington, Texas 76010. The 2.1-GHz units furnish 100 milliwatts or 1 watt, as required. Cost of 10-GHz Gunnplexers are approximately $115 each; cost of 2.1-GHz units are approximately $170 each.

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GLA-1000B Linear Amplifier: 80-15m w/some MARS; 1200w PEP SSB, 700w CW; (4) D-50A's w/tuned input for Solid-State rigs; 125w drive 117/234v; 11"W x 5-3/8"H x 11"D; 30 lbs.

GALION "II" Linear Amplifier: 160-80-40-30-20-17-15 Meter amateur bands; 12 and 10 meters for export only; 2000 watts PEP SSB, 1000 watts CW, RTTY, SSTV, AM; 100% in Amateur Service; 2-Type 3-500Z EIMAC Power Grid Triodes; 2 3-500Z tubes included: 15½"W x 7½"H x 15"D; 49 lbs.

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GLT-1000 Antenna Tuner: 1.8-30 MHz continuous; Tunes wire, coax, balanced line; 1.2 KW PEP; 1 KW CW input; 11"W x 4¾"H x 12"D; 18 lbs.

MLT-2500 2KW Antenna Tuner: 1.8-30 MHz continuous; Tunes coax, wires and balanced line; Wattmeter accuracy ± 10% of full scale; 14"W x 5.5"H x 14"D; 28 lbs.

MLA-2500 C Linear Amplifier: A full 2 KW PEP, 1 KW CW amplifier; Uses two type 8122 output tubes with a total plate dissipation of 800 watts; The new MLA-2500 C is up to date with full coverage of all amateur bands, including the new W.A.R.C. 30, 17, and 12 meter bands, and 160 meters. 14"W x 5.3"H x 14"D; 49 lbs.

Jr. Monitor Tuner: 1.8-30 MHz, 300w, balun; for coax, wire and balanced line. Base or mobile (bracket incl.). 6"W x 3"H x 8"D; 4 lbs.

NDT-300 Tuner: 1.8-30 MHz; built in directional wattmeter with dual meters; wide matching range, built-in 4:1 balance. 14"W x 2"H x 14"D; 8 lbs.

MLX-2500 Transceiver: (NDT Tuner Optional) 160-80-40-30-20-17-15-12-10 Meter amateur bands; USB, LSB, CW; 500 watts PEP SSB, 400 watts CW; 0.5uV for 10 db S/N; 120/240VAC 50/60 Hz Supply built in; All Silicon Solid State Receiver; 2-6MJ6 tubes in transmitter output; 14¼"W x 5¼"H x 14"D; 29 lbs.

MLA-2500 VHF 2 Meter Amplifier: 50-54 MHz, 142-150 MHz; 1800 Watts PEP, 1000 watts F.M. or C.W., 875 watts A.M. Linear; 8122 Ceramic/Metal Tetrodes; 120/240 VAC, 50/60 Hz; 14"W x 5"H x 14"D; 49 lbs.

Clipperton-L Linear Amplifier: 160-15m w/some MARS; 2KW PEP SSB, 1KW DC CW, RTTY/SSTV; (4) 572B's, 65-150w drive; Size: 14½"W x 6"H x 14½"D; 42 lbs.

GLA-500 VHF Amplifier: 144-150 MHz; 500 Watts Input PEP SSB; SSB 50%; CW, FM-35%; 115-120 or 230-240 VAC 50/60 Hz.; 1-4CX250B Metal/Ceramic Tetrode; 11"W x 5½"H x 11"D; 31 lbs.

Clipperton T Antenna Tuner: 2 KW Tuner; 1.8-30 MHz Continuous; Tunes coax, wires or balanced line; 14¾"W x 6"H x 14½"D; 22 lbs.

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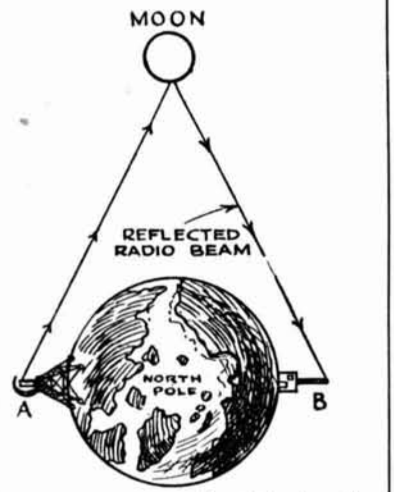


This represents a suggested method of sending a radio wave to the moon and back; to determine by the reception of the reflected wave the permeability of the Heaviside layer. It was proposed in RADIO NEWS *for February, 1929, by H. Gernsback, the editor.*

fig. 1. Hugo Gernsback, the publisher of *Radio News* and many other technical magazines, suggested moon-reflected communications in 1929. It took thirty years for Amateurs to make the dream come true, although military and commercial moonbounce circuits were running soon after World War II.

This year marks the fifty-third anniversary of moonbounce (EME) communications! Happy Birthday, EME!

There are over five-hundred stations worldwide communicating via the earth-moon-earth link today. But the idea was the first proposed in 1929 by Hugo Gernsback, writing in the old *Radio News* magazine (**fig. 1**). Hugo had the right idea, but, like other geniuses, he was years ahead of his time.

more about antennas

Interested in unusual antennas? Here are some that should excite your curiosity.

The Snyder broadband dipole. One of the problems that confront hams operating on the lower frequency bands is the narrow passband of simple antennas close to the earth. Nowhere is this problem more troublesome than on the 80 and 160 meter bands. Both bands are relatively wide in terms of the center frequency and in both cases antennas for these bands are usually very close to the earth (less than a quarter-wavelength for a dipole, in many cases). I heard about the antenna developed and sold by Dick Snyder and my first impression was negative — drawings of the new antenna made it look very much like the discredited "coaxial dipole" which was exposed by Walt Maxwell, W2DU, in *QST* and *ham radio* some years ago.[1]

The temptation to try the new antenna was too great, however, so I ordered the 160-meter antenna to try out against my regular 160-meter dipole. My own 160-meter antenna was certainly poorly positioned. The center was only forty-five feet high and the ends drooped down to within ten feet of the ground, or less. In addition, the last fifty feet of each half of the dipole was doubled back to run around the house in an effort to keep a 250-foot-long antenna on a 150-foot-wide lot! As a result of all this antenna manipulation, the bandwidth of the dipole was very narrow, being less than 70 kHz at the 2.5-to-1 SWR points. Nevertheless, this is typical of

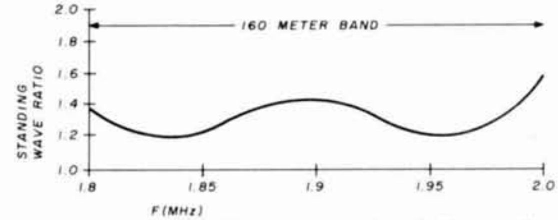


fig. 2. SWR curve for the Snyder 160-meter monoband. *Ham radio* produced a similar curve.

fig. 3. The Snyder dipole straight out of the shipping carton. Center unit holds ferrite impedance-matching transformer.

many ham installations squeezed on a small lot.

With a bit of finagling, the new Snyder antenna went up uneventfully in the same space as the old dipole. My only problem was that I didn't follow instructions exactly and undid both halves of the dipole from the packing straps at the same time. Being made of hard-drawn copper wire, the end sections went — spro-o-ng!! — like a coiled spring and I had antenna all over the place. It took a few minutes to get everything under control again, and this time, following the instructions, I got the new antenna up in the air and was ready for the test.

The Snyder engineer I'd spoken to said that the unique combination of the linear coaxial antenna sections plus the ferrite matching transformer was not really designed for such distorted antenna positioning. Even so, I was pleased to find that the antenna did provide better operating bandwidth over the 160-meter band than did my old dipole.

Since I couldn't do the test properly, I sent the antenna to the *ham radio* staff for further testing. Being out in the wilds of New Hampshire, they have plenty of space to properly install the antenna. They placed the apex at 60 feet and the ends at 35 feet. Their SWR graph, which agreed very closely with Synder's own, shows that the SWR never climbs above 1.5:1 from 1.8 to 2 MHz (see **fig. 2**). That is quite an accomplishment for any antenna.

This is an interesting antenna concept, and I have heard good reports from other hams who have used Snyder dipoles on the higher frequency bands (**fig. 3**). If you want more information, I suggest you write to Snyder Antenna Corp., 250 East 17th St., Suite 1, Costa Mesa, California 92627. And I'd be interested in hearing about your results with this interesting antenna design.

antenna for 160

One of the top-notch operators on 160 meters, as all "low-band" enthusiasts know, is Stew Perry, W1BB. He was working 160 DX when most of us were running around in three-cornered pants. Here's his suggestion for a good beginner's DX antenna for that band (**fig. 4**). It's an easy antenna to erect, tune-up, and load. Basically, it is about 5/8-wavelength long and works against a ground connection. The length is chosen so as to provide as high an input impedance as possible consistent with a simple matching system. Nothing could be simpler than this match — a single series-connected capacitor.

The antenna consists of a 40- to 50-foot vertical wire, top-loaded by a horizontal wire about 120 feet long. Overall wire length should run from 165 to 175 feet. The higher the vertical portion, the better the antenna will work.

As with the old Marconi antenna, the return ground system efficiency is important. W1BB uses several eight-foot ground rods, a nearby buried water-pipe system, and has several buried ground radial wires. For good luck, he's added several above-ground radial wires too. Stew says,

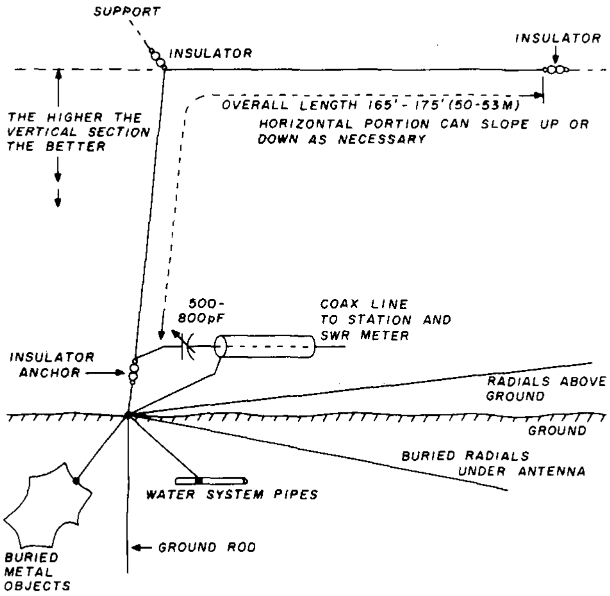


fig. 4. W1BB's suggestion for a good beginner's DX antenna for 160.

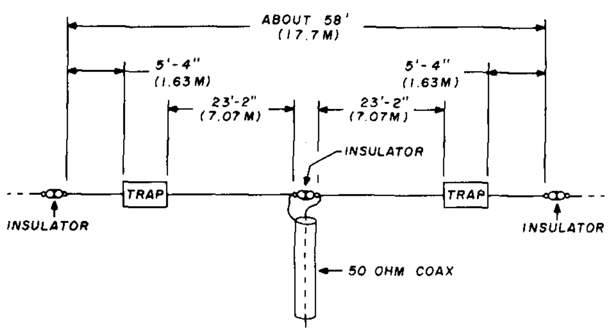


fig. 5. The 30-40 meter dual dipole. SWR is below 1.2 on 30-meter band and below 1.7 on 40-meter band. 40 meter resonance is about 7.13 MHz.

"The better the ground system, the better the results!" A low-voltage variable capacitor of about 700 pF is placed in a water-proof box at the base of the antenna. Simply tune the capacitor for lowest SWR at your pet operating frequency in the 160-meter band. The far-end of the wire may be then pruned for lowest SWR, if desired.

Stew says that with a good ground system, this antenna is almost as good as a quarter-wave vertical with an elaborate ground system. And best of all, it is not as noisy as a straight vertical for receiving. Stew tested the antenna in last winter's DX season, and many 160-meter operators will remember his outstanding signal.

a trap dipole for 30 and 40

If luck is with us, the 30-meter band will be open for U.S. Amateurs within two to three years. Shown in this section is a trap dipole designed for operation on 30 meters as well as 40 meters (**fig. 5**). Simplified traps, such as shown in N3GO's article in *ham radio*[2] are used. These simplified traps can be built in minutes and will work as well as the more complex, discrete-component designs that use separate inductors and capacitors. Trap design is shown in **fig. 6**. If built as shown, they need not be adjusted for frequency.

Overall length of the trapped antenna is about fifty-eight feet, making the design smaller than that for a full-size 40-meter dipole. This is very convenient for the ham with a small-size lot.

The trap is wound on a short section of 1¼-inch outside-diameter clear PVC water pipe. Lengths of RG-58A/U are used for the inductors. Exactly nine and five-eighths turns are required for trap resonance at 10.075 MHz. Each trap requires only about fifty-six inches of coaxial line, nuts and bolts for the termination points, and a length of PVC pipe. What could be cheaper?

When the traps are completed, they may be checked with a dip oscillator. Self-resonance between 9.9 MHz and 10.2 MHz is OK.

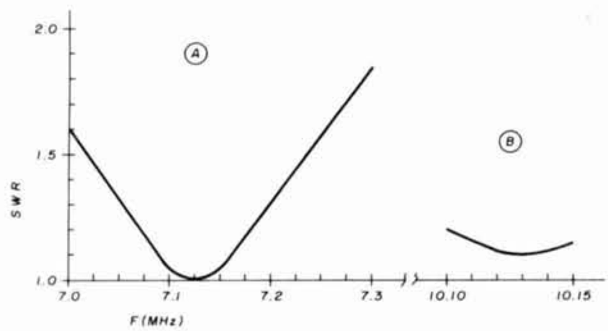


fig. 7. SWR plot of 30-40 meter dipole. A = 40-meter plot. B = 30-meter plot.

Resonance at 10.125 MHz (or thereabouts) is achieved by pruning the center sections of the antenna and resonance at 7.15 MHz is achieved by pruning the tip sections. SWR curves for the antenna described are shown in **fig. 7**.

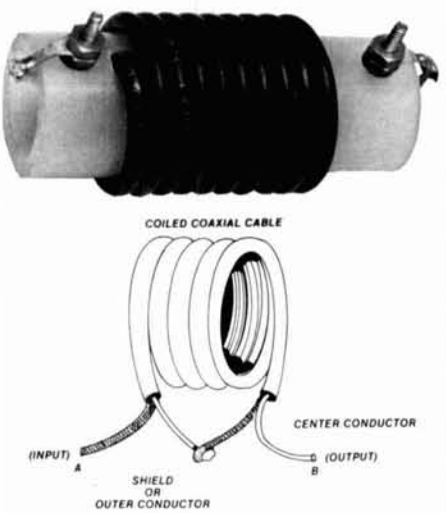


fig. 6. Single-element trap winding detail.

A word of caution. The traps should be protected from the weather. My original traps were exposed and I could notice that the SWR curves shifted when the traps became wet with rain. This was probably caused by an increase in the distributed capacitance between the turns of the trap coil caused by the film of water. The transmission line and ends of the trap windings should be protected from moisture, because water can be sucked into the line by capillary action along the braid wires of the shield.

My first try at sealing the traps was to use a tube of so-called RTV, bought at an auto supply store. This was a disaster — after a few days the metal hardware on the traps turned a nasty green color. I examined the tube of goop and noticed the words *contains acetic acid* among the small print on the back of the tube. So!

I then got a tube of the right stuff, *General Electric* RTV, and noted that no acetic acid was mentioned on the label. The traps were cleaned and the new RTV was slathered over the connections and the ends of the RG-58/U coaxial cable coil. That did the job.

As an alternative, *Dow-Corning* 3145 sealant can be used. It does not have the acid component in the mixture. (Warning! Dow Corning 732 Silastic Sealant, widely available, gives off an acid as it dries out. This, like the cheap so-called RTV, will damage metallic parts.) One learns something new every day.

references

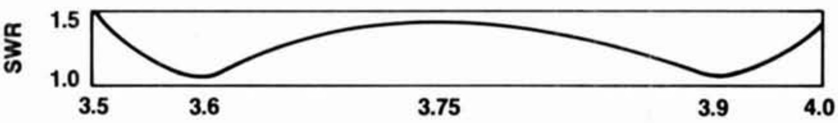
1. Walter Maxwell, "The Broadband Double-Bazooka Antenna — How Broad Is It?" *QST*, September, 1976, page 29. Walt Maxwell, "A Revealing Analysis of the Coaxial Dipole Antenna," *ham radio*, August, 1976, page 46.

2. Gary E. O'Neil, "Trapping the Mysteries of Trapped Antennas," *ham radio*, August, 1981, page 46.

ham radio

More Details? CHECK—OFF Page 92

DIAL THIS ANTENNA DIRECT —NO TUNERS



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  F3/F3E: variable reactance modulator
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  Better than 70dB from 1.8—21.5MHz
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  200W PEP INPUT
- Receiving Mode
  A¹ A³ J (USB LSB) F¹
  F³ (Option)
- Emission Mode
  A³ J SSB (USB & LSB)
  A1 CW
  F1 RTTY
  F3 (28MHz)
- Sensitivity
  SSB CW RTTY Less than 0.3 μv for 10dB S+N/N
  (Preamp - On) Less than 0.15 μv for 10dB S +N/N
  FM (Preamp - On) Less than 0.3 v for 20 dB quieting

DONS CORNER

The Ratings continue - 2 meter mobile month: Kenwood TR9130, excellent sensitivity, easy operation, light output; ICOM IC290A, good performance, cheaper pricing; Yaesu FT480R, great reliability, medium pricing.

ICOM IC25A - Kenwood TR7730 - Yaesu FT 230 - All popular, All the same basic flavor. Yaesu FT208R - biggest seller; Kenwood TR2500 - durable; Santec St144 μP- most features; ICOM IC2AT - basic reliable workhorse.

Consider the various Mod Kits out FOXTANGO, W6TOG, ICOM-Kenwood users, etc.: Our repair dept. has tried several & they are excellent, plus an affordable way to "upgrade" an old radio (TS820?). Remember our service dept. What we can't fix with a hammer, we don't work on.

See you next month!

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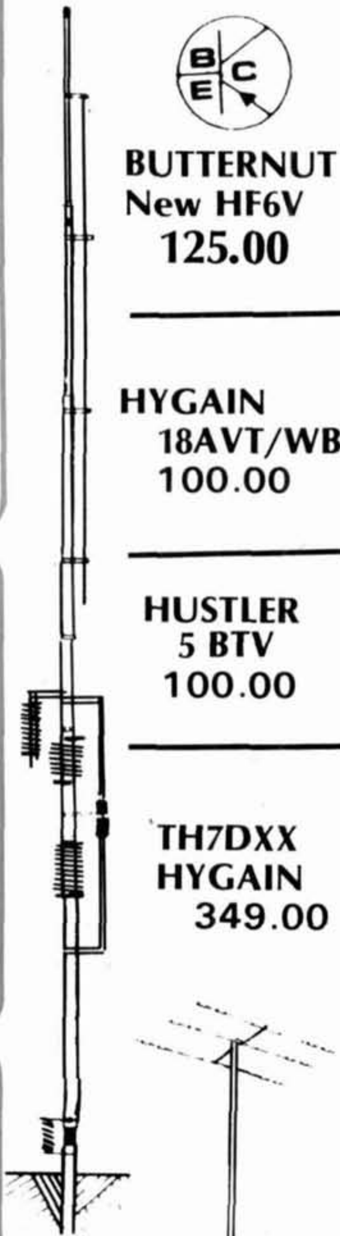

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TR-2500

The TR-2500 is a compact 2 meter FM handheld transceiver featuring an LCD readout, 10 channel memory, lithium battery memory back-up, memory scan, programmable automatic band-scan, Hi/Lo power switch and built-in sub-tone encoder.

TR-2500 FEATURES:

- **Extremely compact size and light weight**
  Measures 66 (2-5/8) W x 168 (6-5/8) H x 40 (1-5/8) D, mm (inches). Weighs 540 grams (1.2 lbs) with Ni-Cd pack.
- **LCD digital frequency readout**
  Shows frequencies and memory channels, four "Arrow" indicators.
- **Ten channel memory**
  Nine memories for simplex or ±600 kHz offset. "M0" memory for non-standard split frequency repeaters.
- **Lithium battery memory back-up**
  (Estimated 5 year life.) Maintains memory when Ni-Cd pack is fully discharged or removed.

- **HI/LOW power selection**
  2.5 watts or 300 mw.
- **Memory scan**
  Scans only channels in which frequency data is stored.
- **Programmable automatic band scan**
  Upper and lower frequency limits and scan steps of 5-kHz and larger.
- **UP/DOWN manual scan**
- **Built-in tuneable sub-tone encoder**
  Tuneable (variable resistor) to desired CTCSS tone.
- **Built-in 16-key autopatch encoder**
- **"SLIDE-LOC" battery pack**
- **Repeater reverse switch**
- **Keyboard frequency selection**
- **Extended frequency coverage**
  Covers 143.900 to 148.995 MHz in 5-kHz steps.
- **Optional power source**
  Using optional MS-1 mobile or ST-2 AC charger/power supply, radio may be operated while charging. (Automatic drop-in connections.)

Actual size

- **High impact plastic case**
- **Battery status indicator**
- **Two lock switches**
  Prevent accidental frequency change and accidental transmission.

Standard accessories include:

- Flexible antenna with BNC connector
- 400 mAH Ni-Cd battery pack
- AC charger

Optional accessories:

- ST-2 Base station power supply/charger (approx. 1 hr.)
- MS-1 13.8 VDC mobile stand/charger/power supply

TR-3500

70 CM FM Handheld

- 440-449.995 MHz in 5-kHz steps
- TX OFFSET switch keyboard programmable ±5 kHz to ±9.995 MHz
- 1.5 W/300 mW HI/LOW power switch
- Auto. squelch position on squelch control
- Tone switch for TU-35B optional programmable CTCSS encoder
- Other features include 10 memories, lithium battery memory back-up, programmable automatic band scan, memory scan, UP/DOWN manual scan, repeater reverse, 16-key autopatch, keyboard frequency selection, slide-lock battery.

Subject to FCC approval.

- VB-2530 2-M 25 W RF power amp., w/cables, mtg. brkt. (TR-2500 only)
- TU-1 Programmable CTCSS encoder (TR-2500 only)
- TU-35B Programmable CTCSS encoder (mounts inside TR-3500 only)
- PB-25 Extra 400 mAH Ni-Cd battery
- PB-25H Heavy-duty 490 mAH Ni-Cd battery
- BT-1 Battery case for manganese/alkaline AA cells
- SMC-25 Speaker-microphone
- LH-2 Deluxe leather case
- BH-2A Belt hook
- WS-1 Wrist strap
- EP-1 Earphone

More information on the TR-2500 and TR-3500 is available from all authorized dealers of Trio-Kenwood Communications, 1111 West Walnut Street, Compton, California 90220.

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Specifications and prices are subject to change without notice or obligation.

Watt's new...on 2 meters?

All mode (FM/SSB/CW) POWER, plus . . . !!!

TR-9130

The TR-9130 is a powerful, yet compact, 25 watt FM/USB/LSB/CW transceiver providing increased versatility of operation on the two meter band. It features six memories, memory scan, memory back-up capability, automatic band scan, all-mode squelch, and CW semi break-in. Available with a 16-key autopatch UP/DOWN microphone (MC-46), or a basic UP/DOWN microphone.

TR-9130 FEATURES:

- **25 watts RF output**
  All modes, (FM/SSB/CW), utilize a new high power linear module, for more reliable FM operation and increased DX on SSB or CW.
- **FM/USB/LSB/CW all mode operation**
  For added convenience in all modes of operation, the mode switch, in combination with the digital step (DS) switch, determines the size (100-Hz, 1-kHz, 5-kHz, 10-kHz) of the tuning or scanning step, and the number of digits displayed.
- **Six memories**
  On FM, memories 1 through 5 for simplex or ±600-kHz offset, with the OFFSET switch. Memory 6 for non-standard offset. All six memories may be operated simplex, any mode.
- **Memory scan**
  Scans memories in which data is stored.
- **Internal battery memory back-up**
  With 9 volt Ni-Cd battery installed, (not Kenwood supplied), memories will be retained approximately 24 hours, adequate for the typical move from base to mobile. A terminal is provided on the rear panel for connecting an external back-up supply.
- **Automatic band scan**
  Scans within selected whole 1-MHz segments (i.e., 144.000-144.9999-MHz).
- **Dual digital VFO's**
- **Repeater reverse switch**
- **Transmit frequency tuning for OSCAR operations**
- **16-key autopatch UP/DOWN microphone version**
- **Squelch circuit on all modes (FM/SSB/CW)**
- **Tone switch**
- **CW semi break-in circuit with sidetone**
- ***Digital display with green LED's***
- **High performance receive-transmit design**
  A low-noise dual-gate MOSFET plus two monolithic crystal filters in the receiver front-end results in excellent two signal characteristics. Care in transmitter design assures clean signals in all modes.
- **Compact size and light weight**
  170 (6-11/16) W x 68 (2-11/16) H x 241 (9-1/2) D mm (inch), 2.4 kg (5.3 lbs.).
- **Extended frequency range**
  Covers 143.9 to 148.9999 MHz.
- **Transmit offset switch**
- **High performance noise blanker**
- **RF gain control**
- **RIT circuit for SSB/CW**
- **Amplified AGC**
- **HI/LOW power switch**
  Selects 25 or 5 watts on FM or CW.
- **Accessory terminal**
- **Quick release mounting bracket**

Optional accessories for TR-9130, TR-9500:

- KPS-7 Fixed station power supply
- PS-20 Fixed station power supply (TR-9500 only)
- BO-9A System base with memory back-up supply
- SP-120 External speaker
- TK-1 AC adapter for memory back-up

More information on the TR-9130 and TR-9500 is available from all authorized dealers of Trio-Kenwood Communications, 1111 West Walnut Street, Compton, California 90220

TR-9500

70 CM SSB/CW/FM transceiver

- Dual digital VFO's cover 430-440 MHz in 100-Hz, 1-kHz, 5-kHz, 25-kHz, or 1-MHz steps. Transmit frequency tuning for OSCAR operations.
- USB, LSB, CW, and FM modes. Facilitates 70 cm OSCAR operations.
- 6 memories, with back-up terminal.
- Automatic band scan of entire band or any 1-MHz segment, memory scan, and SSB, CW search of selected 10-kHz segment.
- HI—10 W, LO—1 W, power output.
- Other convenient features include noise blanker, RIT (SSB, CW) RF gain control, FM squelch, CW sidetone, and basic UP/DOWN mic.

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Introducing the Sinclair ZX81.

If you're ever going to buy a personal computer, now is the time to do it.

The Sinclair ZX81 is the most powerful, yet easy-to-use computer ever offered for anywhere near the price: only $99.95* completely assembled.

Don't let the price fool you. The ZX81 has just about everything you could ask for in a personal computer.

A breakthrough in personal computers.

The ZX81 is a major advance over the original Sinclair ZX80 – the first personal computer to break the price barrier at $200.

In fact, the ZX81's 8K extended BASIC offers features found only on computers costing two or three times as much.

Just look at what you get:

- Continuous display, including moving graphics
- Multi-dimensional string and numerical arrays
- Mathematical and scientific functions accurate to 8 decimal places
- Unique one-touch entry of key words like PRINT, RUN and LIST
- Automatic syntax error detection and easy editing
- Randomize function useful for both games and serious applications
- 1K of memory expandable to 16K
- A comprehensive programming guide and operating manual

The ZX81 is also very convenient to use. It hooks up to any television set to produce a clear 32-column by 24-line display. It comes with a comprehensive programming guide and operating manual designed for both beginners and experienced computer users. And you can use a regular cassette recorder to store and recall programs by name.

Sinclair technology is also available in Timex/Sinclair computers under a license from Sinclair Research Ltd.

HAM CALENDAR

August

SUNDAY | MON | TUES | WED | THUR | FRI | SATURDAY

1

45TH ANNUAL SOUTH HILLS BRASS POUNDERS & MODULATORS HAMFEST — Community College of Allegheny County, Pittsburgh. For more info contact WA3PBD — 1

NIAGARA PENINSULA ARC — Special Event Station celebrating the 100th anniversary of the Royal Canadian Henley Regatta — 1-8*

BIG THUNDER ARC HAMFEST — At Boone County Fairgrounds, Rt 76, Belvidere, IL. For more info, contact SASE to Jim Grimsby, 418 Beacon Dr., Belvidere, IL 61008 — 1

29TH ANNUAL SOUTHWESTERN MICHIGAN VHF FAMILY PICNIC — Sponsored by the Black River ARC, at West Side County Park near Glen. Contact K8Z — 1

17TH ANNUAL HOCKLEY COUNTY ARC PICNIC AND HAMFEST Co-sponsored by the Northwest Texas Emergency Net to be held in the Levelland, Texas city park — 1

24TH ANNUAL FM PICNIC AND HAMFEST — Sponsored by the Steuben County Radio Amateurs at Crooked Lake, Angola, IN — 1

2

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6

50TH ANNUAL W1MU AMATEUR RADIO CONVENTION West Yellowstone Convention and Civic Center, W. Yellowstone. For more info contact K7ENE — 6-8

7

TRI-COUNTY ARC ANNUAL HAMFEST/PICNIC — Held at Los Angeles County Fairgrounds, Pomona, CA. For more info, contact TCARA Hamfest Chairman W6ELZ, POB 142, Pomona, CA 91769 — 7

EUROPEAN C.W. CONTEST — 7-8

DARC WAE C.W. CONTEST — 7-8

A5 FSTV UHF CONTEST — 7-8

ARRL UHF CONTEST — 7-8

GREATER JACKSONVILLE HAMFEST ASSOCIATION'S 9TH ANNUAL HAMFEST & ARRL CONVENTION — Orange Park Kennel Club. For more info contact NX4G — 7-8

8

VALLEY OF THE MOON ARC 3RD ANNUAL "HAM" BREAKFAST & SWAPMEET — Sonoma Community Center, 276 East Napa St., Sonoma, CA. Contact VOMARC, 358 Patten St., Sonoma, CA 95476 — 8

MID-ATLANTIC ARC ANNUAL J.B.M. HAMFEST — Route 309 Drive-In theater, Montgomeryville, PA. For more info contact Mid-Atlantic ARC, POB 352, Villanova, PA 19085 — 8

ST. CLOUD RADIO CLUB HAMFEST — Held at Sauk Rapids Municipal Park, Sauk Rapids, MN. For more info, contact Mike Lynch, 2115 1st St., St. Cloud, MN 56301 — 8

CENTRAL KENTUCKY ARRL HAMFEST — Sponsored by Blugrass ARS at Scott County H.S., Longlick Road at US route 25, Georgetown. For more info contact K4DHN — 8

9

10

AMSAT East Coast Net 3850 kHz 8PM EST (0100Z Wednesday Morning)

AMSAT Mid-Continent Net 3850 kHz 8PM CST (0200Z Wednesday Morning)

AMSAT West Coast Net 3850 kHz 7PM PST (0300Z Wednesday Morning)

11

12

13

TEXAS VHF SOCIETY'S 1982 SUMMER MEETING — Nassau Bay Resort Motor Inn, Johnson Spacecraft Center, Houston. For more info contact Texas VHF FM Society, Summer Session, POB 73, Texas City, TX 77590 — 13-15

ALLIANCE ARC EXHIBITION — The Alliance (OH) ARC will exhibit emergency radio communications during Carnation week at Silver Park — 13-15

14

ENGLEWOOD ARA 23RD ANNUAL NEW JERSEY QSO PARTY — 14-16*

BURLINGTON ARC — Annual Hamfest, Burlington, VT 05402 — 14-15

HAMFAIR 82 — Sponsored by the Radio Club of Tacoma at the Pacific Lutheran University campus. For more info, AD7S — 14-15

BERRY'S MOUNTAIN ARC DXPEDITION — 14*

15

IOWA 75 METER NET — Picnic and swapfest at River Valley Park, Ames, IA. For info, contact WB0JFF, Net Sec — 15

TIPPECANOE ARA'S 11TH ANNUAL HAMFEST — Tippecanoe Fairgrounds, Teal Rd. and 18th St., Lafayette, IN. For tickets and info, contact Lafayette Hamfest, Rt. 1, Box 63, West Point, IN 47992 — 15

7TH ANNUAL NEW DELMARVA HAMFEST — Gloryland Park, Bear. For more info, contact Stephen Momot, K3HBP, 14 Balsam Rd., Wilmington, DE 19804 — 15

16

17

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21

HURON COUNTY ARC — Celebrates 169th anniversary of the Battle of Lake Erie on South Bass Island in Lake Erie. For special QSL card after making contact, send QSL and SASE to ARS KF80 — 21-22

RAMAPO MOUNTAIN ARC, WA2SNA — 6th annual flea market held at Oakland American Legion Hall, 65 Oak St., Oakland, NJ. For more info, contact WO2AAI — 21

HUNTSVILLE HAMFEST — Held at Von Braun Civic Center, Huntsville, AL. Free Admission. For more info, contact Huntsville Hamfest, POB 4563, Huntsville, AL 35802 — 21-22

TIOGA COUNTY ARC 6TH ANNUAL HAMFEST — To be held at Island Park, just off US Rt. 15, Blossburg, PA. For more info, contact KC2AZ — 21

MARYSVILLE HAMFEST — Sponsored by Union County ARC at the Marysville Fairground. For more info, contact UCARC, 13613 US 36, Marysville, OH 43040 or call (513) 644-0468 — 21-22

SARTG RTTY CONTEST — 21-22

22

ST. CHARLES ARC HAMFEST '82 — To be held at Wentzville Community Club. For more info, contact SCARS Hamfest, c/o W00GSY — 22

ILLINOIS STATE ARRL CONVENTION — Sponsored by Fox River Radio League at Kane County Fairgrounds, St. Charles, IL. For more info, contact KA9HQY or WD9GIG — 22

23

24

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AMSAT West Coast Net 3850 kHz 7PM PST (0300Z Wednesday Morning)

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ALL ASIAN C.W. CONTEST — 28-29

29

4TH ANNUAL GCARC HAM/COMPFEST — Sponsored by the Gloucester County ARC at the Gloucester Community College, Tanyard Rd., Sewell, NJ. For more info, contact club at POB 370, Pitman, NJ 08017 — 29

LEBANON HAMFEST — Sponsored by Short Mountain Repeater Club, held at Cedars of Lebanon State Park, US 231, Lebanon, TN. For more info, write Mary Alice Fanning, KA4GSB, 4936 Danby Dr., Nashville, TN 37211 — 29

1ST ANNUAL DXPEDITION OF KANSAS STATE UNIVERSITY ARC AND MANHATTAN AREA ARS — Held in Pott County. For certificate, SASE to W0QQQ, Electrical KSU, Manhattan, KS 66506 — 29

30

31

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AMSAT Mid-Continent Net 3850 kHz 8PM CST (0200Z Wednesday Morning)

AMSAT West Coast Net 3850 kHz 7PM PST (0300Z Wednesday Morning)

W1AW Schedule

April 25-October 24, 1982 — MTWThFSSn: Days of Week — Dy: Daily

W1AW code practice and bulletin transmissions are sent on the following schedule

EDT	Slow Code Practice	MWF 9 A.M., 7 P.M.; TThSSn 4 P.M., 10 P.M.
	Fast Code Practice	MWF 4 P.M., 10 P.M.; TTh 9 A.M.; TThSSn 7 P.M.
	CW Bulletins	Dy 5 P.M., 8 P.M., 11 P.M.; MTWThF 10 A.M.
	RTTY Bulletins	Dy 6 P.M., 9 P.M., 12 P.M.; MTWThF 11 A.M.
	Voice Bulletins	Dy 9:30 P.M., 12:30 A.M.
CDT	Slow Code Practice	MWF 8 A.M., 6 P.M.; TThSSn 3 P.M., 9 P.M.
	Fast Code Practice	MWF 3 P.M., 9 P.M.; TTh 8 A.M.; TThSSn 6 P.M.
	CW Bulletins	Dy 4 P.M., 7 P.M., 10 P.M.; MTWThF 9 A.M.
	RTTY Bulletins	Dy 5 P.M., 8 P.M., 11 P.M.; MTWThF 10 A.M.
	Voice Bulletins	Dy 8:30 P.M., 11:30 P.M.
PDT	Slow Code Practice	MWF 6 A.M., 4 P.M.; TThSSn 1 P.M., 7 P.M.
	Fast Code Practice	MWF 1 P.M., 7 P.M.; TTh 6 A.M.; TThSSn 4 P.M.
	CW Bulletins	Dy 2 P.M., 5 P.M., 8 P.M.; MTWThF 7 A.M.
	RTTY Bulletins	Dy 3 P.M., 6 P.M., 9 P.M.; MTWThF 8 A.M.
	Voice Bulletins	Dy 6:30 P.M., 9:30 P.M.

*SEE COMING EVENTS

eight-channel memory scanner for the Sony ICF-2001

Modifications to increase the versatility of this general-coverage receiver

A low-cost modification to the Sony model ICF-2001 receiver allows sequential sampling and automatic acquisition of any eight active frequencies from 150 kHz to 30 MHz. This modification uses eight readily available ICs and adds a significant degree of automation to a variety of monitor applications without inhibiting any of the original receiver functions.

The ICF-2001 receiver provides some surprisingly professional state-of-the-art features. I had seen this receiver in numerous magazine ads for a year or so before deciding to consider it as a second or backup monitor receiver. The key pad frequency entry (without any bandswitching) and up-down incremental tuning took a little getting used to after years of using the R-390A and other vintage receivers. However, once I adapted, I discovered its outstanding frequency stability and tuning accuracy attributes, which are the product of phase-locked-loop (PLL) synthesizer design. Admittedly, this receiver's selectivity is no match for the R-390A, but other features such as small size, low power consumption, ease of operation and utility have given it a prominent position in my station. For those interested in the considerable number of signals outside the ham bands (for example, RTTY press, aeronautical and maritime communications), the general-coverage aspects of the ICF-2001 should have great appeal.

some uses

The ability to store six preset frequencies for instant pushbutton recall and the capability to scan continuously between two preset frequencies and automatically stop on active signals were of particular interest. Repeated use of the scan mode of operation in the receiver led to the design of the following modification, which has permitted continuous sequential scanning of the memory channels with automatic dwell capability on active channels. Although these search-dwell features are common in the popular VHF-UHF scanners, their use in high-frequency receivers is restricted primarily to expensive special-purpose equipment. Some of the uses I have found to be convenient in the modified receiver include the ability to determine unpredicted band openings without dedicated listening and to maintain a "quiet" speaker watch on several fixed-net frequencies for out-of-schedule activity, particularly emergency and rescue nets.

By **Bill Farmer, W3CSW**, 16920 Glen Oak Run, Rockville, Maryland 20855

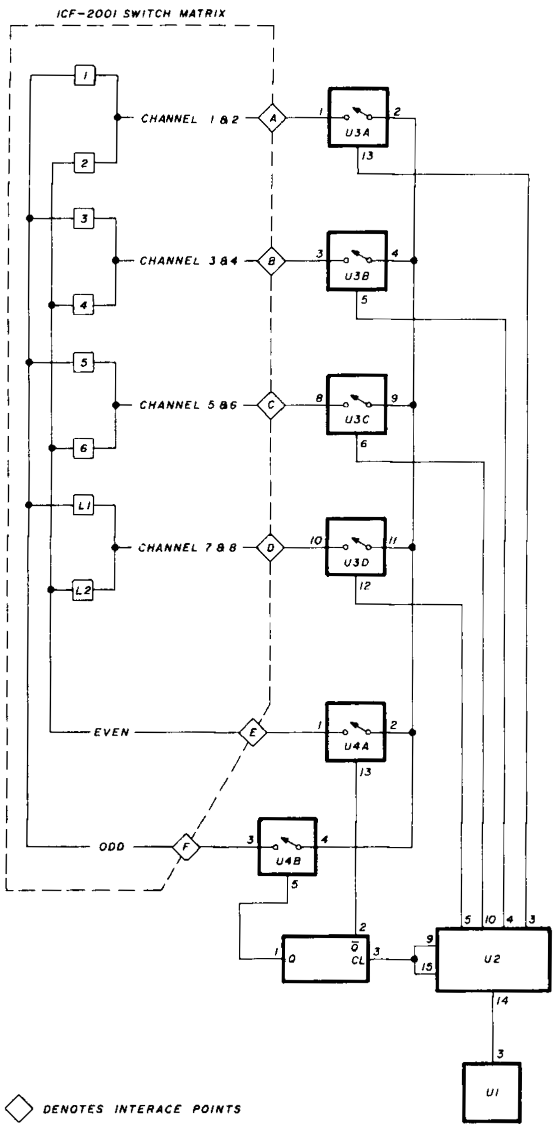


fig. 1. Simplified schematic of CMOS switching scheme, existing pushbutton switch matrix and interconnecting points.

about the circuit

For automatic sequencing of the pushbutton memory channels, a scheme of electronic switching connected in parallel with the existing memory channel and scan limit pushbuttons is used. As shown in **fig. 1**, the basic circuit uses CD4066 quad bilateral switches controlled by a CD4017 one-of-ten counter and a CD4013 dual D flip-flop. Timing pulses are generated by an XR-L555 low-power timer. Pulses generated by U1 cause U2 pins 3, 4, 10, 5, and 9 to alternately go high for one count each. This action sequentially pulses CMOS switches in U3, which are connected to one side of the ICF-2001 pushbutton switch matrix. As U2 pin 9 goes high, it resets the timing sequence and clocks U5, which alternately closes and opens CMOS switches in U4A or U4B. These switches are wired to the ODD and EVEN sides of the switch matrix. This cyclic operation causes odd-numbered memory channels 1-3-5-7 to be scanned (turned on and off in sequence), followed by even-numbered channels 2-4-6-8. Pushbuttons for channels 7 and 8 are actually the high and low search limit switches labeled L1 and L2 on the ICF-2001. This switching scheme is relatively straightforward and has been gleaned from previously published articles and application notes featuring the CD4066 and CD4017 ICs.[1,2,3]

additional circuits

There are a number of additional supporting circuits that must be incorporated if this automatic scanning feature is to serve a useful purpose. These

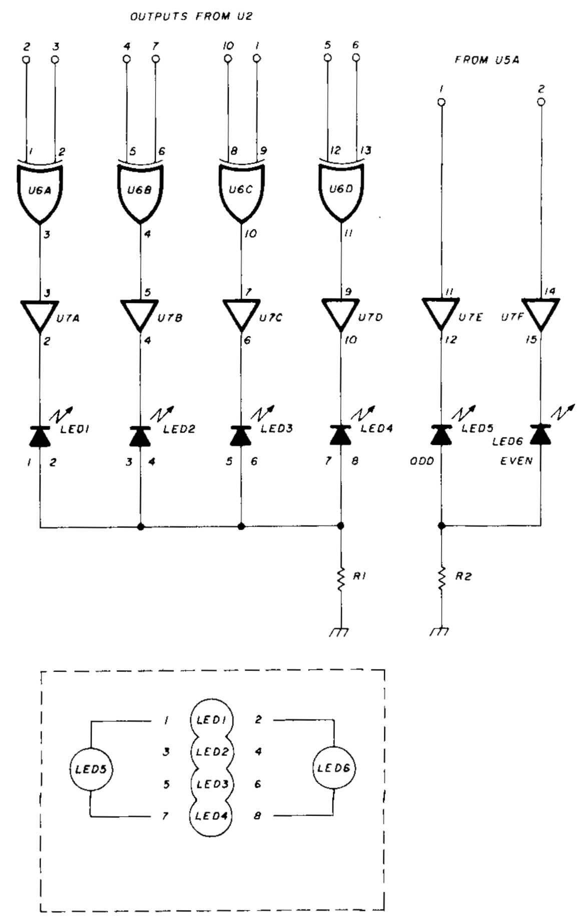


fig. 2. Channel-indicating circuit composed of LEDs (A), to show which channel is active or is being scanned. The front panel layout of LED1 through LED6 is shown in (B).

circuits will (a) provide a visual indication of which memory channel is being scanned or becomes active, (b) provide a means to automatically stop scanning when a signal occupies a memory channel, (c) cause the scan feature to resume search when signal activity ceases, (d) mute the receiver audio during scan (if desired), and (e) allow normal receiver pushbutton operation when not using the memory scan mode. These circuits make use of only three additional ICs and the unused portions of U4 and U5 plus a general-purpose NPN transistor and reed relay. **Fig. 2** depicts the use of U6 (quad exclusive-OR gate) and U7 (hex buffer), which drive six LEDs to provide visual indication of scanned or active channels. Sequencing for these ICs and LEDs is provided by the controlled sequential outputs of U2 for the four numbered LEDs; and, from U5A, Q and $\overline{Q}$ outputs for the ODD and EVEN LEDs. Resistors R1 and R2 provide current limiting for the LEDs. While scanning, the ODD and EVEN LEDs will alternately light, while the numbered LEDs will indicate which memory channel switch closures are occurring.

pause or dwell function

This portion of the circuit makes use of a section of the existing receiver circuit that automatically stops the original L1 and L2 search functions mentioned earlier (continuous search between two preset frequencies). An examination of the ICF-2001 schematic and a lot of trial and error probing revealed a point in the receiver that latched high (about +3 volts) during received-signal conditions and remained low during "no-signal" conditions. These levels are sufficient to trigger a D flip-flop in U5 and control operation of one of the leftover CMOS switches in U4.

Fig. 3 illustrates a simplified circuit that uses this "signal presence" point, G, to both automatically stop the memory scan and start delay time-out clock U8. This circuit allows the automatic-scan cycle to resume following a four- to six-second delay after a received signal goes off the air. Additionally, this part of the modification will allow muting the receiver audio during memory scan operation. During a scan, U5B provides the primary operating voltage ($+V_{CC}$) to U1, the scanner clock, through the Q output of U5B.

If a signal is detected in the memory channel being scanned, point G will swing to +3 volts. This causes U5B to reset, which removes power from U1. The delay time-out clock, U8, is powered up through U5B's $\overline{Q}$ output, turning on Q1 and RY1, whose normally open contacts are in series with the ICF-2001 speaker voice coil. Notice also that with a received signal present and +3 volts at point G, which turns on CMOS switch U4C, the time-out-clock charging capacitor C1 is shorted. This prevents or delays the

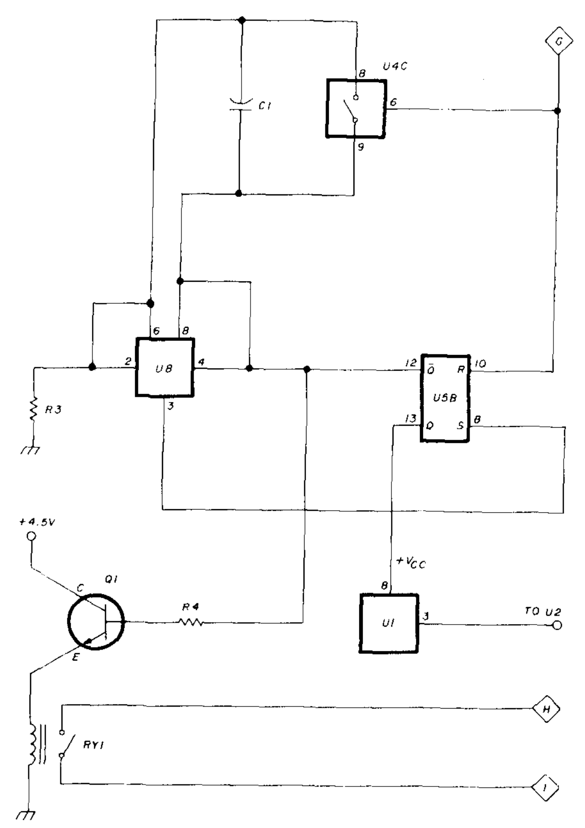


fig. 3. Simplified circuit that provides automatic scan stop and re-start functions as well as audio squelch and delay timeout provisions.

U8 and R3C1 timing function until a "no signal" condition causes point G to go low. The stop-scan condition will prevail as long as a signal is present and +3 volts are maintained. The RC time constant for U8 was empirically derived to account for QSB and other random "no signal" conditions that are observed in high-frequency CW and SSB communications. Once the signal goes off the air, or fades for longer than 4 to 6 seconds, U8 times out, which results in a high at pin 3 providing a set condition for U5B and resumption of scan with muted audio.

additional circuit functions

The remaining add-on features are best described using **fig. 4**, the overall schematic. (A parts list is provided in **table 1**.) Notice that switch S1 (a 3PDT toggle switch) performs three separate functions. S1A enables or inhibits U2 to permit manual stop-start of memory channel scanning. S1B opens the receiver switch matrix ODD-EVEN common connection so that in the MANUAL (non-scan) mode, no switch connections are closed that would preclude normal pushbutton operation of the receiver. Finally, S1C is inserted in parallel with RY1's contacts so that normal unsquelched audio is always available in the MANUAL mode.

Three other switches appear in **fig. 4** that perform the following optional, but recommended functions. When S2 is in the eight-channel position, all eight memory channels are scanned as described earlier. However, when switched to the four-channel position, S2 disables U5A flip-flop action, causing repetitive scanning of only four ODD or four EVEN channels. By manually toggling S2 while in the MANUAL, or non-scanning, mode, the ODD or EVEN LED will indicate whether channels 1-3-5-7 or 2-4-6-8 will be scanned when S2 is finally placed in the four-channel position. This simple option permits segregating ham- and non-ham-band frequencies of interest into

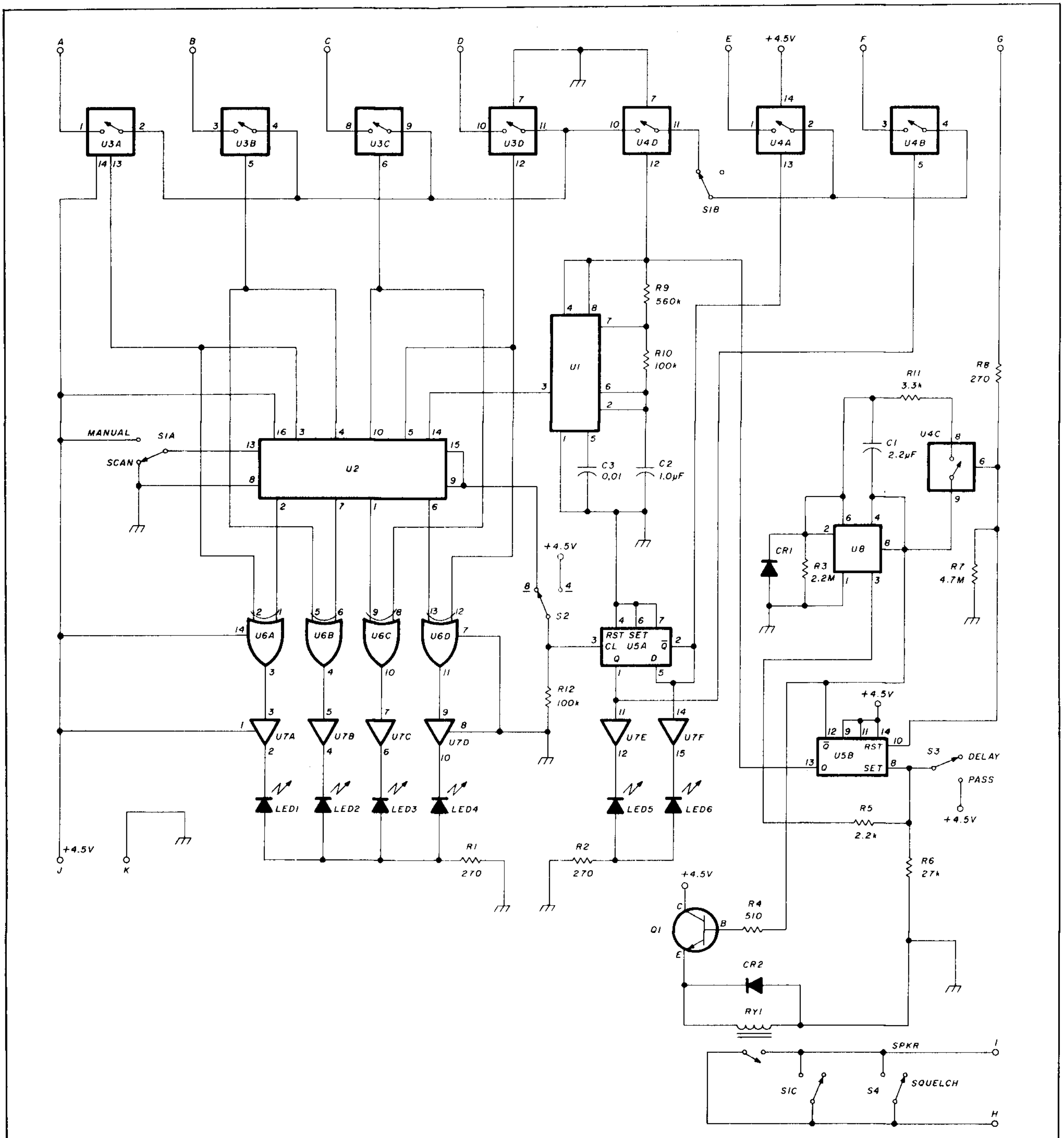


fig. 4. Overall schematic diagram of memory scanner modification.

table 1. ICF-2001 scanner modification parts list.

symbol	description
C1	2.2 μF 35V tantalum
C2	1.0 μF 35V tantalum
C3	0.01 μF 50V disc ceramic
CR1, 2	1N914 diode
LED1-6	light-emitting diodes, nominal 10 mA, Jameco XC526R
Q1	2N3904 NPN
R1	270 ohm ¼ watt
R2	270 ohm ¼ watt
R3	2.2 megohm ¼ watt
R4	510 ohm ¼ watt
R5	2.2 kilohm ¼ watt
R6	27 kilohm ¼ watt
R7	4.7 megohm ¼ watt
R8	270 ohm ¼ watt
R9	560 kilohm ¼ watt
R10	100 kilohm ¼ watt
R11	3.3 kilohm ¼ watt
R12	100 kilohm ¼ watt
RY1	5 Vdc SPDT mini relay, Jameco HA1-5
S1	3PDT toggle switch, Jameco 7301P3
S2-4	SPDT toggle switch, Jameco JMT-123
U1	XR-L555
U2	CD4017
U3	CD4066
U4	CD4066
U5	CD4013
U6	CD4070
U7	CD4050
U8	XR-L555

separate groups of four channels for selective monitoring.

Switch S3 is added to the SET pin of U5B to momentarily break audio squelch as signals are acquired during scan without stopping the scan sequence. The switch is labeled DELAY and PASS to denote normal scan delay with the four to six second time-out as previously described, or to pass up active channels after briefly listening to the active channel's audio. I found this mode useful when monitoring specific channels for expected activity that were already in use by other stations. Momentary aural samples of a channel allow continuous uninterrupted scanning action along with enough aural information to know when a channel is no longer in use.

The final switch, S4, which is labeled SPKR/SQUELCH is a switch in parallel with RY1 contacts to allow normal audio output while in the scan mode. The repetitive *ker-chunk, ker-chunk* as the receiver steps through empty channels is not normally desired. However, this provision is included to permit aural recognition of weak signals that are unable to develop sufficient AGC action in the receiver to cause automatic scan stop.

Incidentally, the ICF-2001 is no slouch in the sensitivity department considering its fixed 6-kHz i-f bandwidth. Comparative tests showed that signals in the quarter microvolt region are aurally discernible, and that typically signal levels of about S6 to S8 were sufficient for automatic signal acquisition by the modified receiver. A separate project to improve the selectivity of the ICF-2001 is currently on the drawing board.

interface connections

A *total of eleven interface connections* must be made to the ICF-2001. These connections are indicated in the figures as A through K and are shown pictorially in **figs. 5** and **6**. Dense packaging within the radio will demand careful attention to detail while making these connections. I found that mounting a small prewired multipin connector through the rear of the radio near the D-cell battery compartment gave good internal access and allowed unencumbered use of the set with the modification unplugged. The use of small color-coded ribbon cable is recommended for all interior connections. There's no room here for your 500 watt plumber's iron, so muster the lowest wattage pencil iron and smallest tip you can find. Remember, you are working with CMOS devices so ensure all handling and soldering is done in a static-free environment.

Begin by removing all batteries and the six Phillips-head retaining screws that hold the front and back sections of the radio together. Ensure the external antenna terminals are screwed in tight, then carefully separate the two halves of the radio, resting the heaviest half (speaker, battery compartments and main PC board) on the working surface, while propping the front-panel half up at about a 90 degree angle. Next remove the single Phillips-head screw securing the speaker, and lift the speaker up, out and to the left of your work (refer to **fig. 5**).

Carefully unsolder and remove the two-color (red/white) striped lead from the speaker *voice-coil* terminal. This lead represents interface point H and

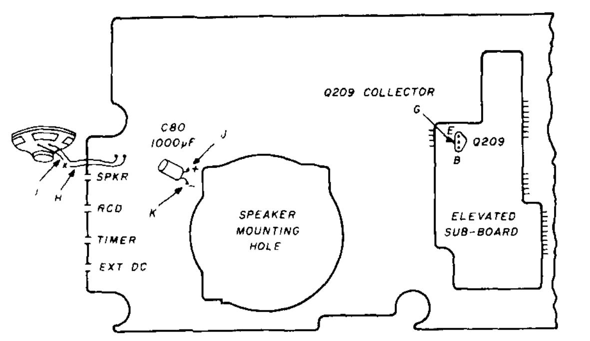


fig. 5. Pictorial of receiver interconnecting points G through K located on the main receiver PC board.

the now vacated speaker terminal interface point I. The solid-color (white) speaker lead is the speaker ground connection and is left as is. Next, isolate the 1000-μF electrolytic capacitor (C80), which is mounted on the main receiver PC board between the speaker mounting hole and the external SPKR/PHONE jack. The positive and negative terminals on this capacitor form interface points J and K respectively, which will provide about 4.5 volts dc power for the modification circuit. Just to the right of the speaker mounting hole, an elevated PC sub-board with many ribbon-wire connections will be found. This raised sub-board contains Q209 in the upper left corner. The base, collector, and emitter leads of Q209 are outlined and marked on the board. The center pin and lead (collector) of Q209 is interconnect point G.

The next six connections will be made to PC boards located beneath the front-panel pushbutton. To locate these connection points, first remove the Mylar foil shields that cover these PC boards. Referring to **fig. 6**, interconnect point D will be found on the lower left corner of the frequency-entry key pad, and the last five connecting points will be found on the left edge of the memory channel pushbutton PC board. These last five connections are made on the solder eyelets, which are vertically oriented and contain white, blue, yellow, red, and brown wires that interconnect the two boards. This concludes the work within the receiver. Ensure good lead dress to allow proper closure of the set. Additionally, mark the multipin connector terminals that correspond to audio leads H and I. These two terminals must now be shorted together for normal receiver operation without the scanner mod attached.

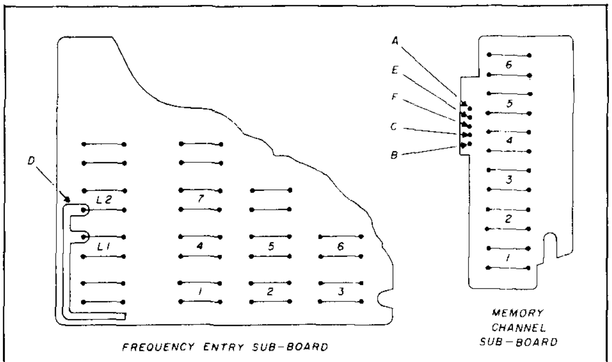


fig. 6. Pictorial of receiver interconnecting points A through F located beneath the frequency entry and memory channel pushbutton switches.

packaging and construction

Due to the "cigar-box" shape of the ICF-2001, I chose to mount it and the scanner mod on a 7-inch (17.5 cm) rack panel, which conforms to the rack-mount layout of my station. However, other arrangements such as mounting the scanner mod in a small sloping panel enclosure for desktop operation could be used. The scanner mod can be easily packaged within an area of about 3 × 4 × 1-inches (7.5 × 10 × 2.5 cm) using IC sockets and standard perf board with conventional point-to-point or wire-wrap connections. There are no critical lead length or layout precautions to observe. However, upon completion of the project and before connecting it to the receiver, some preliminary checks should be made:

1. Power up the scanner mod using a 4.5- to 5-volt dc source to ensure that manual start-stop of the timing and LEDs is occurring.

2. Check interface points A through G with the scanner mod powered up to ensure that less than about 0.6 volt dc to ground appears at these points. A high on any one of these points indicates a wiring error, which must be corrected before connecting the mod to the receiver.

3. Check the total current consumption of the mod, which should be on the order of 7 mA. This additional demand on the receiver is easily accommodated along with the nominal 150 to 200 mA requirements of the receiver from the external power supply furnished with the ICF-2001, which is rated at 4.5 volts dc at 600 mA.

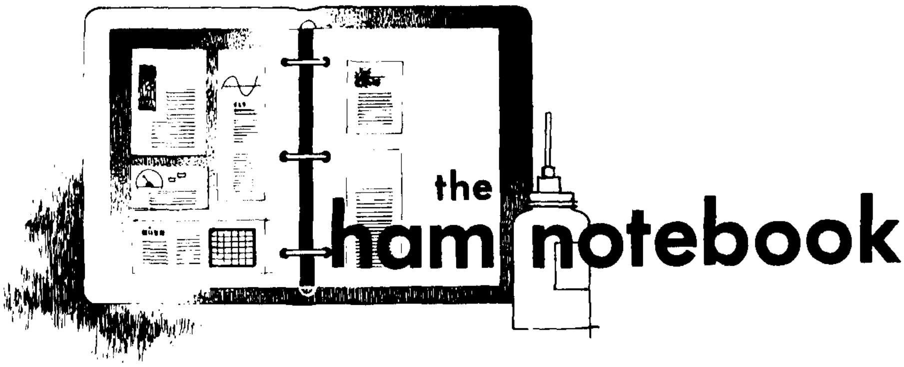
a final word

I've had this scanner modification in almost continuous use since August, 1981, without a hitch. While the modifications described in this article are directed toward the Sony model ICF-2001, the same techniques could apply to other digital receivers such as the Panasonic RF-6300 boasting twelve pushbutton memory channels. The modest cost of the ICF-2001 (under $300) and its increased utility after modification provide a new dimension in high-frequency monitoring, which has heretofore not been within the means of the average Amateur. I'd be pleased to correspond with anyone considering use of this modification and would appreciate any ideas on other applications or modifications contemplated for the ICF-2001. I'd be most grateful for a self-addressed, stamped envelope with all correspondence.

references

1. Forrest M. Mimms, "A Programmable Function Generator," *Popular Electronics*, January, 1982.
2. Howard M. Berlin, *555 Timer Applications Sourcebook*, first edition, second printing, 1979.
3. Don Lancaster, *CMOS Cookbook*, first edition, second printing, 1977.

ham radio



R-1000 mod

Owners of the Kenwood R-1000 receiver have probably wondered how they can listen to signals in the 200-500 kHz band without getting QRM from broadcast station images. I had this problem and solved it by installing a lowpass filter in series with the antenna.

I had at first anticipated that the 30-foot-long antenna wire I was using could be tuned with an antenna tuner. But that did not work because the R-1000 low-frequency-antenna input is 1000 ohms and would still pick up these images. This high input impedance is hard to work with, but a lowpass filter does the job!

construction

I built my filter in a small metal box using 0-400 pF variable BDC-type capacitors — not compression-type (see **fig. 1**). Other than the capacitors and a box, all I needed was an inductance. The J.W. Miller #2007 Loop Stik, which tunes 540-1650 kHz with an inductance of 150-1000 μH and a Q of 220 at 790 kHz, works perfectly. The slug was adjusted far enough into the core so that the capacitors would tune. Two feed-through insulators were used on the can for input and output. The unit should be shielded to prevent the BDC signals from bypassing the filter.

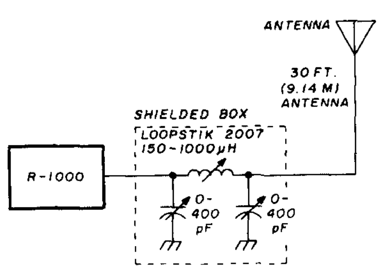


fig. 1. Lowpass filter for the R-1000.

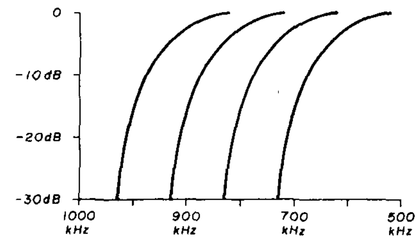


fig. 2. As the two variable capacitors are increased in value, the cut-off point of the filter goes lower in frequency and it attenuates the broadcast signals, which come in as an image on the receiver. Copying a signal on 475 kHz, you can only approach so close to 500 kHz and still have the 475-kHz signal. It does, however, eliminate or attenuate signals from 600 kHz to 1000 kHz well enough to make the 200-500 kHz band on the R-1000 useful. Instead of dozens of images there may be only several from local BDC stations.

adjustment

I adjusted my filter by tuning in a ship broadcast on CW at 475 kHz with both capacitors all of the way out, and an interfering BDC station coming in. Then gradually I increased the capacitance until the BDC station disappeared and all that was left was the ship broadcast station. See **fig. 2.**

This is the only device I have been able to find that makes this band and the 180-kHz non-license band usable.

Ed Marriner, W6XM

improved keying for the HW-8

My Heath HW-8 exhibited an excessively long rf output decay time. This resulted in choppy sounding CW at the higher keying speeds. Above about 25 WPM the output became a steady carrier even though the sidetone sounded good.

The problem was traced to the break-in delay circuit (**fig. 1**). Capacitor C92 was discharging through Q12 causing keying transistor Q11 to remain in conduction for over 100 milliseconds after the key was released. The solution was to reconfigure Q12 to function as an ordinary diode. When the key is up, Q12 is reverse biased, effectively disconnecting C92 from the keying circuit.

To make the modification, simply remove resistors R66 and R67 (both 4700 ohms). Then solder a jumper wire between the base and collector of Q12. This modification had no noticeable effect on the break-in delay circuit or the setting of the delay control.

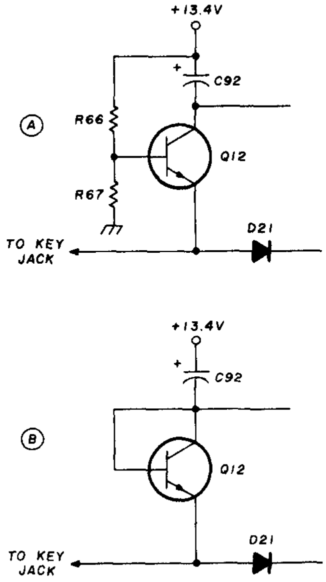


fig. 1. Original break-in delay circuit of the Heath HW-8, A. The improved circuit, B, eliminates choppy-sounding CW at higher keying speeds.

Robert W. Lewis, W3HVK

More Details? CHECK—OFF Page 92

(Comments continued from page 8)

time until the same resolution is applied to 220 and 440? Probably the only reason these are not in danger now is that the pertinent CATV channels are not nearly so widely in use — but they will be as the CATV operators expand the number of channels they distribute.

The entire problem with respect to Amateurs can be resolved in either of two ways: (1) Take away virtually all the Amateur VHF-UHF bands, or (2) Deactivate three CATV channels out of the one hundred or so authorized. The third alternative, eliminating leakage points is simply not practicable. The systems are too complex, and subject to too many uncontrollable factors.

There is at least one thing Amateurs can do: present the facts to their local city council. CATV operators are franchised by the local community (not by the FCC), and Amateurs can often get a sympathetic ear at the local level — especially if their contributions to the community during emergencies and in other public service endeavors are pointed out. The cities would probably be willing to tell the CATV franchise to avoid using one (or at most, three) channels if that was all it took to preserve Amateur Radio in the community.

Frank Bates, AA6C
Santa Clara, California

the Zepp

Dear HR:

The excellent article by WØWL on the 40 and 80 meter center-fed Zepp antenna doesn't tell all. With proper antenna-tuning network, this antenna is an excellent all-band antenna. Also, by reducing the flat top length to 68 feet and using 66-foot feeders, you'll find that it will do a fine job on 80 through 10 meters. The 33 feet above ground is fine. After putting up this antenna in Florida I took down my three-element beam.

C.R. Sellwood, W2RHQ
Liverpool, New York

CRT character enhancer

A way of making your CRT readout even more readable

The purpose of this article is to give you clearer and easier-to-read video on your CRT display. Understanding why there is a problem with clarity on CRT screens requires that you first understand a few basic facts about TV and video-monitor CRT displays.

the problem

No TV or video monitor is really capable of producing the picture that you see on your CRT screen. Scanning devices make you think you see a picture by faking your eye into believing there is a whole picture there. In fact, there is only one dot at a time being produced by the electron beam as it strikes and excites the phosphor on the CRT screen. As time passes, the beam scans from left to right and top to bottom, painting an apparent picture on the screen. It is the persistence of the phosphor — that is, its ability to store or stay lit — that results in the picture you see on the screen. Therein lies the essence of television, and therein also lies a problem when you try to get nice, sharp characters, numbers, or symbols on the screen.

The scan rate from left to right (63.5 μs) is much faster than the line-by-line sweep from top to bottom (16.66 ms). This results in the dots in any given horizontal line tending to "slur," or run into one another. Without a sharply defined space between them, the dots begin to look like a line even though you don't really want them to. Even if a full-TV-type interlace system is used there is still some defined black space vertically between lines. And normally, on monitors and video displays, this is even more pronounced because interlace is not used. Therefore a full line of black exists between the lines vertically.

the ideal, and the difficulty of reaching it

Look at **fig. 1. Fig. 1A** shows a perfect string of horizontal dots, all clean and round. It would be nice if any monitor did this, even under ideal conditions, but they usually do not. **Fig. 1B** shows what in fact the eye will see when objects such as dots are identi-

By David J. Brown, W9CGI, RR 5, Box 39, Noblesville, Indiana 46060

cal, or even very similar in shape; or when they are very small, or your viewing distance relative to the dot size is large; or when the dots are very close together or slightly touching. **Fig. 1C** shows the visual results of finite turn-on and turn-off times in video amplifiers, display tube, and gun. Even the phosphor has an inherent delay time. **Fig. 1D** shows how the eye's lack of definition (**1B**) plus the CRT timing effects (**1C**) combine to cause an apparent line to form where a horizontal dot string should be showing.

How this affects your eye's ability to read a string of characters, or even define a single character, becomes clear when you look at the sample character string in **fig. 2A**. I have exaggerated the effect a little by simply showing the horizontal dot string as solid lines, just the way they really appear on your CRT screen. By sharp contrast, note the ideal appearance of the same character string in **fig. 2B**.

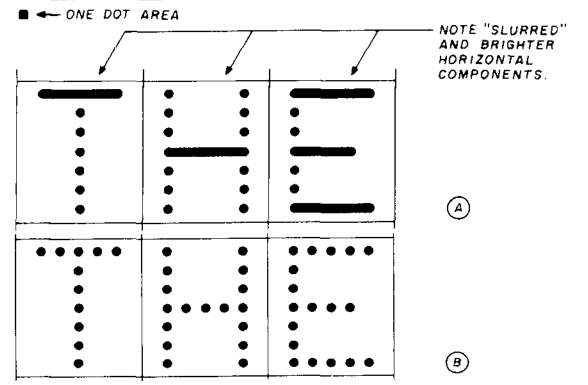


fig. 2A In *A*, the unmodified CRT screen, horizontal rows of dots run together to produce characters of unequal brightness. In *B*, modified characters of equal brightness result in far less eye strain and fatigue.

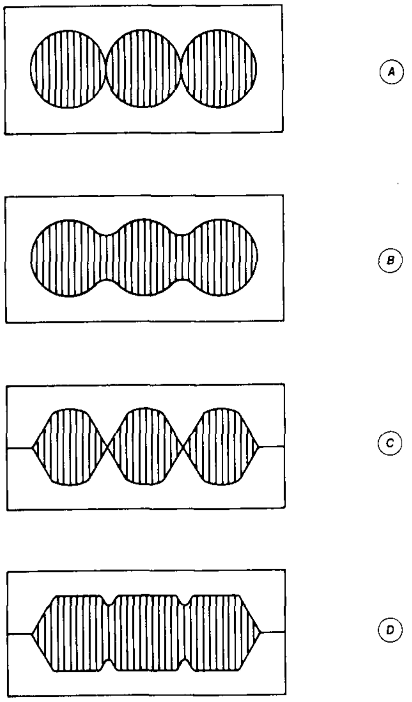


fig. 1. What you see on your CRT screen: *A*, a perfect string of dots as they might be seen under ideal conditions; *B*, the apparent running together of dots caused by lack of definition in the human eye; *C*, the effects of turn-on and turn-off times in the video amplifiers, display tube, gun, and even in the phosphor itself; *D*, the combined effects of *B* and *C*.

the eyes have it

The eye is a compensating light receptor, and as such will "open up" and "close down" (in various areas of the field of vision simultaneously) to respond to the different light intensities of **fig. 2A**. By contrast, the dot string in **fig. 2B** causes only minor fluctuations in light intensity — and far less eye fatigue. *An additional benefit is that errors in reading are also reduced.* Characters of even density, or "weight" as it is called in drafting, are much easier to read. Most people can read them quickly and accurately, because the eye has less work to do.

Now that you see the problem, try to imagine how difficult this printed page would be to read if all the horizontal components of each character were bolder or blacker than the vertical components. IT IS DIFFICULT TO DO THAT IN PRINTING, SO I HAVE ASKED THE MAGAZINE TO PRINT THIS SENTENCE IN ALL UPPER-CASE LETTERS. This should allow you to at least visualize the problem I am referring to, because upper-case letters have a lot more horizontal components. Most hobby computers use all upper-case letters in their visual displays, so the problem becomes magnified.

Take another look at **fig. 1D**. We could eliminate this dot-pairing effect if we could just drop a hole, or "off" time, into that slurred line between the dots. In **fig. 3A** you can see the effect this has. It separates the dots. Ignoring the weird appearance of the dots for a moment, I think you will at least agree that they no longer look like a line. The shape of these dots is, I admit, less than perfect.

The turn-off delay of any switch I might use to shoot the horizontal line of dots full of holes also has the effect of smoothing out — sloping the edge of — the dot. See **fig. 3B**. Now we are getting back to a dot that at least looks like a dot. As I would in CW, I am simply wave forming, shaping, and filtering. In CW it is done to avoid the harsh on/off transitions that cause chirps and clicks. This is the same idea exactly, but here it is done for the benefit of the eye rather than the ear. First, the hole is inserted to sharply define the space between two legitimate dots. Then, the effect of switch times and various elements in the video chain rounds off the harsh edges, much like CW filtering.

Since every computer is different, I can't tell you where to begin component by component. I can, however, give you a description of the stages to look for, the facts you need to know or find out, and the reason my modifications will cure the problem.

Find the video sector of your machine and try to determine the polarity and amplitude (TTL, and so forth) at as many places within that area as you can. Since many machines use TTL logic, my examples will be in TTL. In your own case, just make sure the two signals you will be working with are logic-and level-compatible with each other as well as the device you will end up combining them in.

My machine is totally homebrew, but as an example, in my final video stages I had run the video through a noninverting gate (7409) just to buffer it and give me an uncommitted (non-totem-pole) output to interface to the TTL stages that follow. That involved taking the two inputs together, so that a high at the input creates a high at the output. A high, in my case, represents video enabled — a dot. Further, each dot in my system has a period equal to a full cycle of the resident clock frequency.

I wanted to use the resident clock frequency for several housekeeping chores in the computer, so I had allowed earlier for six buffered clock outputs. These are all square waves at the clock frequency, so they are high for one half the period; low for the other half. You will have to look for the same type of

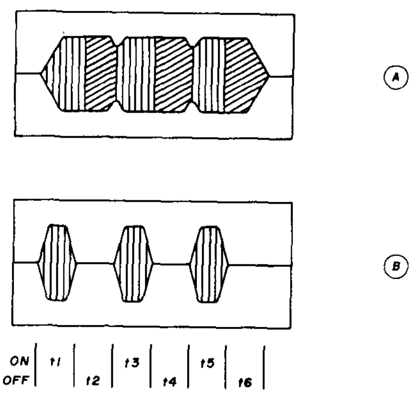


fig. 3. ***A*, Horizontal dots with "holes" inserted. In *B*, the dots have been rounded somewhat by filtering and the delay inherent in switching.**

signal in your machine: half-cycle on (high), half-cycle off (low), for the period of one dot in your character display. Careful! This will not necessarily be the clock frequency in some machines. It is in mine, because I chose it to be so. What you want is a clocking frequency that can be used as a gate control to turn off half a dot.

Except for performing the actual surgery, you are essentially through once you've located the following: the clock frequency or appropriate gate signal stage, which you may have to buffer; the video at the same type level, which might take a few additions; and a stage to combine them in (you will probably have to add this in a commercial computer, but look around for unused gates). There are a few pitfalls to avoid here, so your first try may not be perfect. Let's go over them one at a time.

1. Careful surgery and soldering are crucial!

2. Careful wire routing is mandatory.

(a) Keep video leads away from any of the rather large pulses found in the deflection circuits of the monitor/CRT display. If your computer is not in the same box as the monitor/CRT, or is hidden under the keyboard, as in the TRS-80, so much the better.

(b) Stay away from the high-voltage lead on the CRT with everything, including your fingers!

(c) Clock-signal wiring must be routed so that nothing gets into it, to preserve the computer integrity. It must also be routed to keep it out of everything else, except the gate to which you are routing it.

(d) Don't use a vacant gate, no matter how tempting, if it involves making long runs to get there and back. An inexpensive 7409 and socket added somewhere in the video territory is by far a better way to go.

(e) Make the clock-signal lead the longer one, and locate the gate right in the video region, if you have the option of doing it that way or the other way around.

3. Be careful of mixed logics, levels, voltages, polarity, and above all, isolation methods.

(a) Isolation should not be a problem, as you should be working all inside the computer. I caution you only because a lot of monitor/CRT displays run "hot" chassis systems. Be careful.

(b) Logic and levels will probably work out all right, but beware of a few mixed-mode TTL/MOS systems.

(c) Voltages for the added gating device, if needed, should be easy to find, as most computer

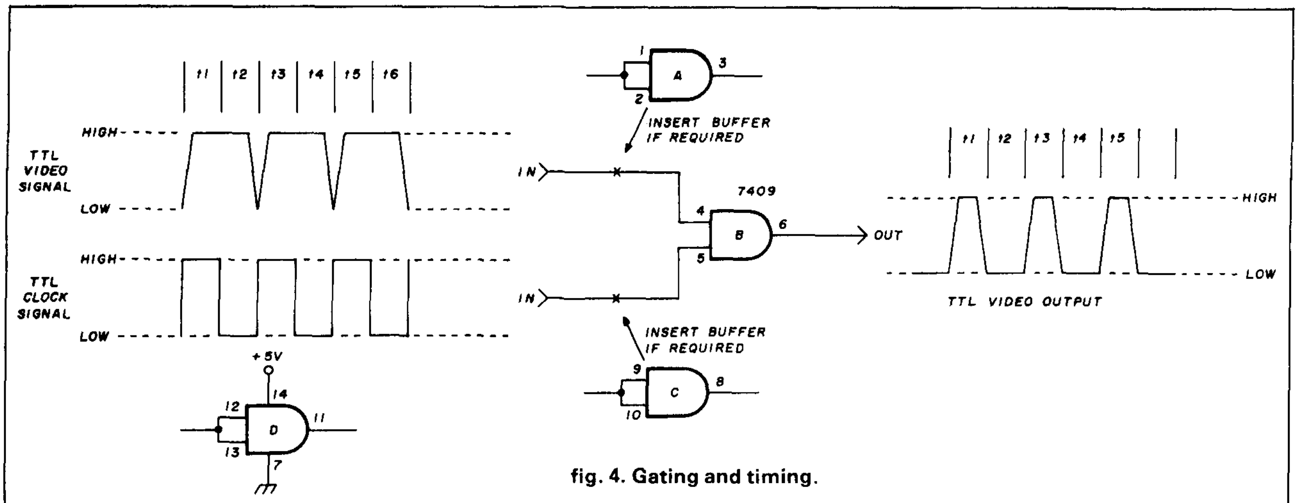


fig. 4. Gating and timing.

manufacturers wisely use oversize buses or copper pads on the + voltage and ground lines. If you must stand up the new gate, put a small 30 to 50 volt ceramic capacitor of about 0.1 μF from + V to ground right at the added socket's + V and ground pins. This is a precaution against trash pick-up or generation.

(d) That leaves polarity, and I mention it only to keep you from doing what I did while modifying a friend's computer. I inadvertently got one or two signals inverted trying to use existing gates. It was easily cured but most embarrassing. Use a bit of forethought and add little (⊓) (⊔) symbols to your schematics if they are not already there, to show signal polarity at various points.

4. RFI?

(a) All computers generate radio-frequency interference. But nearly all of them nicely confine it inside the computer.

(b) If you have one of the out-in-the-open board-type computers, your own keyboard, or — in short — a modular system, you may want to run an RFI check before and after. A shortwave radio and small antenna, tuned to the clock rate frequency you used, will work fine. You might even want to check your commercial, closed-up system just for your own protection against TVI complaints.

summary

I hope this simple two-signal, one-gate approach will convince you how easy this conversion is to accomplish. I have included **fig. 4** to get you off on the right track.

Another change you will notice will be in the brightness, or drive of the display. You can compensate for this by simply turning up the drive or contrast control. Don't worry about anything you may have heard about some people burning up CRTs by using high drive settings for TV games. This is not the same thing at all. With all computer characters, the white (on) to black (off) ratio, or duty cycle, is very low, and your turning up the drive on your new half-dot system is really going to give you a *lower* duty cycle than you had before. Each dot is now only approximately 50 percent of what it was. With all the dots now looking more or less the same, turning up drive in the new system will brighten all of the dots smoothly and evenly.

Set up the brightness and contrast/drive portion of your controls just as I hope you have been doing all along for best picture: Turn brightness up until you see the rectangle in grey that forms the visual page the characters will appear on. Then turn the brightness down until the grey area just turns black like the surroundings. With a few characters typed in, turn up the contrast (drive) control until the characters are pleasing to your eyes and bright enough to be read in the surroundings in which you are working. In some monitors, there is interaction between brightness and contrast, so be patient and go back and forth; the added time is worth it if you are going to be working at your computer any length of time. Also, if you have a choice between a brighter screen or a darker room, darken the room for less eye strain. If you are copying from a written page, tilt it up as a typist does, and direct a small lamp at the page. Keep the difference in lighting levels between the page and screen as small as possible. This, too, will make for a lot less eye strain. Home computing should be fun, and the easy-on-the-eyes format my system will give you is well worth the effort of installing it.

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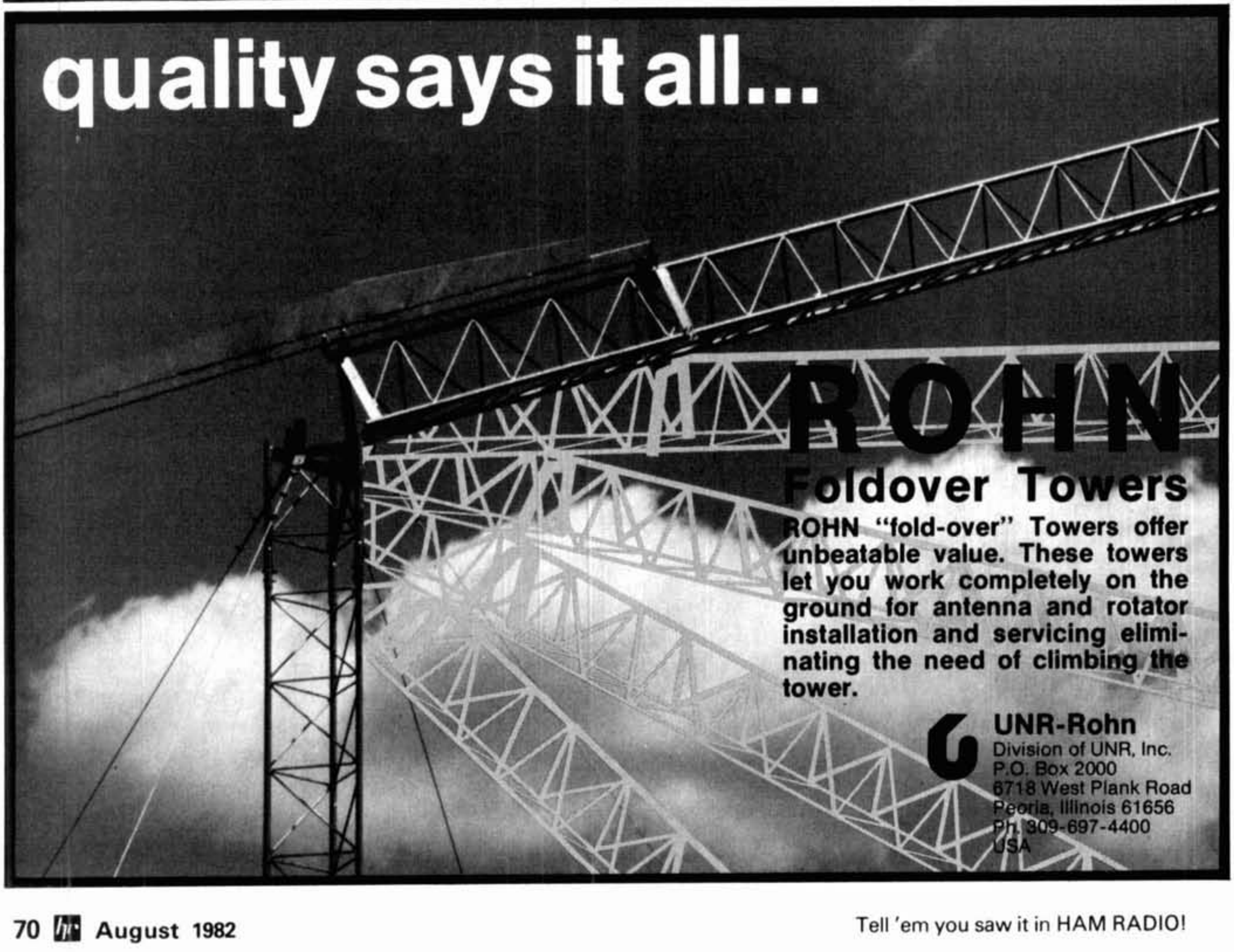

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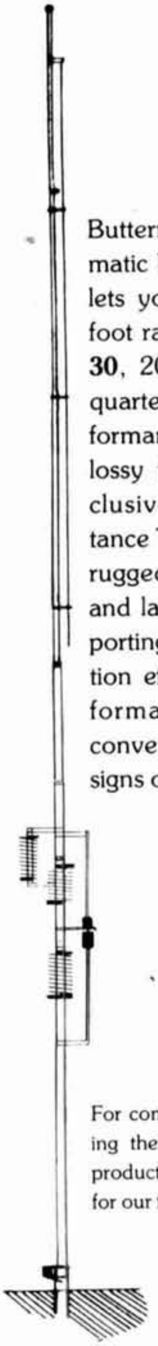

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ACTIVITIES

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ALABAMA: The Huntsville Hamfest, Saturday and Sunday, August 21 and 22, Von Braun Civic Center, Huntsville. Free admission. Prizes, exhibits, forums, air-conditioned flea market, non-ham activities. Family tours of the Alabama Space & Rocket Center available. Limited camp sites w/hookups available. Flea market tables $4/day. Talk in on 3.965 and 34/94. For information: *Huntsville Hamfest*, PO Box 4563, Huntsville, AL 35802.

CALIFORNIA: The Valley of the Moon Amateur Radio Club's third annual "Ham" breakfast and Swapmeet Sunday, August 8, 9 AM to 4 PM, Sonoma Community Center, 276 East Napa Street, Sonoma. Breakfast features sausage, eggs, pancakes, o.j., *coffee, tea all for* $3.50 adults and $1.75 children under 12. Swap tables $5.00 or bring your own. Admission, including raffle ticket, $1.00. Children, YLs and XYLs free. Open auction 2 PM, raffle 3:30 PM. Computer and Amateur TV displays; an operating 10 meter FM station. Talk in on 147.47 simplex and 146.13/73 local repeater. For information: Darrel, WD6BOR (707) 938-8086. For swap space reservations send $5.00 to VOMARC, 358 Patten Street, Sonoma, CA 95476.

FLORIDA: *The Platinum Coast Amateur* Radio Society's 17th annual Hamfest, September 11 and 12, Melbourne Auditorium. Swap tables, meetings, forums, awards, tailgating. For information/reservations: PCARS, PO Box 1004, Melbourne, FL 32901.

GEORGIA: The Central Georgia Amateur Radio Club's fourth annual Central Georgia Hamfest and ARRL State Convention, Saturday and Sunday, September 11 and 12, Warner Robins Recreation Center, 800 Watson Blvd., Warner Robins. Indoor and outdoor flea markets at $3.00 per space per day. Bring your own tables. Donation at door $1.00, 6/$5.00 and 13/$10.00. Meetings and forums. Activities for YLs and Harmonics. Talk in on the Frank King Memorial Repeater, 146.25/85. Ample motel space nearby. Hospitality room open Friday night and "pickin' and grinnin' " on Saturday night. For information: Jim Piper, W4HON, *618 American Blvd., Warner Robins*, GA 31093.

SOUTHERN ILLINOIS Shawnee Amateur Radio Association's 26th Hamfest will be September 12 at John A. Logan College in Carterville, Illinois. Offerings include air-conditioned flea market, prizes, forums, computers, refreshments, contests. For details QSL Bill May, KB9QY, 800 Hilldale, Herrin, IL 62948 or 618-942-2511 days.

ILLINOIS: The Fox River Radio League again hosts the Illinois State ARRL Convention as part of its annual Hamfest at the Kane County Fairgrounds, St. Charles, Illinois, August 22. Commercial exhibits, flea market, demonstrations, contests, forums, and hot food. Exhibitors, dealers, and vendors *contact: G.R. Isely, WD9GIG,* 736 Fellows Street, St. Charles, IL 60174. Tickets $2.00 advance, $3.00 at gate. For advance tickets send SASE: J. Dubeck, KA9HQY, 1312 Bluebell Lane, Batavia, IL 60510.

INDIANA: The Tippecanoe Amateur Radio Association's 11th annual Hamfest, Sunday August 15, Tippecanoe County Fairgrounds, Teal Road and 18th Street, Lafayette. Grounds open 7 AM. Tickets $3.00. Flea market, dealers, refreshments and prizes. Talk in on 13/73 or 52. *For tickets and information:* Lafayette Hamfest, Route 1, Box 63, West Point, IN 47992.

INDIANA: The 3d annual Grant County Amateur Radio Club Hamfest, September 11, McCarthy Hall, St. Paul's Church, Marion. Donation $2.00 advance; $3.00 gate. Refreshments, free parking and hourly prizes. Talk in on 146.19/79 or 146.52 simplex. For information/tickets SASE to Beecher Waters, WB9YHF, RR #1, Box 357, Converse, IN 46919.

IOWA: The Iowa 75 meter Net will hold a picnic and swapfest, Sunday, August 15, River Valley Park, Ames. Pot luck lunch at noon followed by a program and prizes. Talk in on 16-76. For information: WBØJFF, Net Sec.

KENTUCKY: The Central Kentucky ARRL Hamfest sponsored by the Bluegrass Amateur Radio Society, Sunday, August 8, Scott County High School, Longlick Road at US Route 25, Georgetown. Tickets $3.50 advance; $4.00 gate. Flea market, forums, awards. For information: Ernie Cohen, K4DHN.

MAINE: *The Augusta Emergency Amateur Radio Unit's* Northeast area Hamfest, September 10, 11 and 12, Windsor Fairgrounds, off Route 17, 10 miles east of Augusta. Flea market, speakers, demonstrations and more. Camping facilities available. Talk in on 146.22/82 and 3940. An award will be made to an Amateur from northern New England, Quebec or the Maritimes who has made a significant contribution to Amateur Radio. Nominations should be by letter to Windsor Hamfest Committee, W.E. Jackson, W1WCI, RFD #1, Box 3970, Winthrop, ME 04364.

MICHIGAN: The Grand Rapids Amateur Radio Association's annual Swap and Shop, Saturday, September 18, Hudsonville Fairgrounds. Gates open 8 AM for swappers and public. Prizes, dealers, indoor sales, outdoor trunk swap. Talk in on 146.16/76. For information: Grand Rapids, ARA, PO Box 1248, *Grand Rapids, MI 49501.*

NEW JERSEY: The Ramapo Mountain Amateur Radio Club, WA2SNA, 6th annual flea market August 21, Oakland American Legion Hall, 65 Oak St., Oakland, only 20 miles from the GW bridge. Admission $1.00; tailgating $3.00. Non-ham family members free. Door prizes include an Icom IC-2AT. Talk in on 147.49/146.49 and 52. For information: Walt Zierenberg, WD2AAI, 344 Union Avenue, Bloomingdale, NJ 07403. (201) 838-7565.

NEW JERSEY: The Sussex County Amateur Radio Club's fourth annual Hamfest, September 11, Sussex County Farm and Horse Show grounds, Plains Rd., Augusta. Registration $2.00. Door prizes. Outdoor flea market sellers: $4 preregistered; $5 gate. Indoors $5 preregistered; $6 gate. Talk in on 147.90/30 and 146.52. For information/registration: Sussex County ARC, PO Box 11, Newton, NJ 07860 or Lloyd Buchholtz, WA2LHX, 10 Black Oak Drive, Vernon, NJ 07462.

NEW JERSEY: 33d annual W3PIE Gabfest, Saturday, September 11, Club grounds, Old Pittsburgh Road, off Route 51 and 119 By-pass, Uniontown. Preregistration $2.00 each, 3/$5.00. Free swap and shop setup with registration. Free coffee. First prize: Ten-Tec Argosy 525 HF. Other prizes VoCom 2 meter amp. 2CO25, V.O.M. Meter, Cushcraft 5 band vertical, Hustler 2 meter beam *and many more. DX contest $50.00 cash prize.* XYL prizes. Computer, OSCAR demos. Refreshments. Talk in on 147.045-645; 144.57 - 145.17 and 146.52-52. For information: U.A.R.C. Gabfest Committee, John T. Cermak, WB3DOD, PO Box 433, Republic, PA 15475. (412) 246-2870.

NEW YORK: The Elmira Amateur Radio Association's seventh annual International Hamfest, September 25, Chemung County Fairgrounds. Gates open 6 AM, breakfast available. Limited Friday night camping available at fairgrounds. Nearby camping facilities. Free flea market, dealers, door prizes. Grand prize: Icom IC-730 with PS. Second prize: Icom IC-25A. Third prize: Kenwood station clock. Talk in on 147.96/36, 146.10/70 and 146.52 simplex. Tickets $3.00. Advance tickets $2.00 from John Breese, 340 West Avenue, Horseheads, NY 14845.

OHIO: The Findlay Radio Club Hamfest is celebrating its 40th anniversary on September 12, 1982, Hancock Recreational Center Arena, N. Main St., I-75, exit 161. Open 6:30 AM to 5:00 PM. Largest Hamfest in Northwest Ohio, second in state. Tickets $2.00 advance, $3.00 at entrance. Exhibit tables are $5.00 per table. Flea market trunk sales $2.00 per space. Open Saturday for setups and evening entertainment. Talk in 147.75/15. Check in 146.52/52. For reservations and tickets SASE to Findlay Radio Club Hamfest, PO Box 587, Findlay, Ohio 45840.

PENNSYLVANIA: The Skyview Radio Society's annual Hamfest, Sunday, September 19, noon to 4 PM, Club Grounds, Turkey Ridge Road, New Kensington. Registration $2.00. Vendors $4.00. Awards. Talk in on 04-64 and 52 simplex.

PENNSYLVANIA: The Central Pennsylvania Repeater Association's 9th annual Hamfest/Computerfest, September 5, Harrisburg Farm Show parking lot, off US Route 81, Cameron St. exit. Gates open 8 AM. Registration $3.00. Sellers $5.00 per 10 ft. space. Tailgating $1.00. Talk in on 144.87/5.47, 146.16/.76 and .52 MHz. For information and map: Irvin Sanders, K3IUY, RD #3, Box FA53, Harrisburg, PA 17112. (717) 469-2185.

PENNSYLVANIA: The Butler County Amateur Radio Association's annual Hamfest, Sunday, September 12, 9 AM to 4 PM, Butler Farmshow Grounds, Roe Airport, Butler. Mobile checkin 147.96/36 and 52 simplex. Directions 147.84/24. Mobile prize awarded. Fly-in (Butler Farmshow Airport). Fly-in prize awarded. Donation $1.00. Children under 12 free. Overnight camping. Indoor flea market $3.00 per 8 ft. table. Free outside flea market. Refreshments. Prizes include: Kenwood TS-830S, Kenwood TR-7730, Kenwood TR-2500 Handheld. For information: Leighton Fennell, Crestmont Drive, RD 6, Butler, PA 16001. (412) 586-9822.

TENNESSEE: The Lebanon Hamfest, sponsored by the Short Mountain Repeater Club, Sunday, August 29, Cedars of Lebanon State Park, U.S. 231, Lebanon. Outdoor facilities only. Exhibitors bring own tables. Refreshments available. Talk in on 146.31/146.91. For information: Mary Alice Fanning, KA4GSB, 4936 Danby Drive, Nashville, TN 37211.

TEXAS: The Texas VHF Society's 1982 summer meeting, August 13, 14, 15, Nassau Bay Resort Motor Inn, Johnson Spacecraft Center, Houston. Special tours of NASA, exhibits, flea market, Ham astronaut speaker, space shuttle communications, VHF & ARRL seminars. Prizes include all-mode VHF transceiver. Preregistration for all three days $5.00 includes one free prize ticket. $1.00 for each additional ticket. Registration at door $6.00, no prize tickets. Talk in on 146.04/.64 and 147.75/.15 repeaters. For preregistration information: Texas VHF-FM Society, Summer Session, PO Box 73, Texas City, TX 77590.

TEXAS: The first annual Wichita Amateur Radio Society's Hamfest, September 25 and 26, National Guard Armory, Wichita Falls. Preregistration $4.00. At door $5.00. Preregistration prize, grand prize, and other prize drawings. Dealers, computer demonstrations, flea market, refreshments. Ladies activities and prizes. Talk in 146.34/94 and 147.75/15. Free RV parking at armory. No hookups. Help celebrate Wichita Falls 100th birthday. Citywide activities.

WASHINGTON: Radio Club of Tacoma Hamfair '82, PLU Campus, Tacoma. 147.28. Contact AD7S.

OPERATING EVENTS

"Things to do..."

AUGUST 14: The Berry's Mountain ARC's first DXpedition commemorating the 165th continuous year of operation of the Millersburg Ferry, founded in 1817, and consisting of two stern-wheel ferryboats left in the United States today. The "Falcon" will carry a 40 meter station and the "Roaring Bull", 20 meters. Other stations will operate dockside. Using the callsign W3TS, club members will operate from 1200 until 2400 GMT. Frequencies: 3.910, 7.045, 7.125, 7.245, 14.045, 14.295, and 147.24/84. For a pictorial commemorative certificate and a full historical survey of this unique and colorful ferry, send your QSL, a business-size SASE and 25¢ to: W3TS, Dana Michael, RD 1, Box 144, Lykens, PA 17048.

AUGUST 29: The first annual DXpedition of the Kansas State University ARC and the Manhattan Area ARS to Flush, Kansas in Pott. County. WØQQQ will operate 24 hours continuously beginning 0000 UTC. Frequencies: CW 21.112 MHz or 7.112 MHz. Phone 14.292 MHz or 3.892 MHz. For a handsome 8 × 10 certificate, SASE to WØQQQ, Electrical Engineering Dept., Kansas State University, Manhattan, Kansas 66506.

SEPTEMBER 11: The Canisteo Valley Radio Amateurs will operate special event station WB2SQX from 1400Z to 2100Z to commemorate the 50th anniversary of the "Canisteo Living Sign", the world's largest living sign. Frequencies: 7245, 14.285, 21.375, 28.650 MHz ± QRM. SWLs eligible too. A special aerial color photo QSL of the living sign is available for your QSL plus business SASE to John S. Babbitt, WB2SQX, Square Woods Drive, Canisteo, NY 14823.

SEPTEMBER 11 AND 12: The Cray Valley Radio Society's 12th SWL contest, from 1800 GMT September 11 to 1800 GMT September 12. There will be two sections, phone and CW, each with two categories, single and multi-operator. Bands: 1.8, 3.5, 7, 14, 21 and 28 MHz. Send business SASE for log sheets to Owen Cross, G4DFI, 28 Garden Ave., Bexleyheath, Kent. Entries should be sent to contest manager, G4DFI, at above address no later than November 1, 1982. Certificates of merit will be awarded by the board of the Cray Valley RS.

SEPTEMBER 4-12: The Southern Counties Amateur Radio Association, SCARA, is planning a special events station during the Miss America Pageant at the Atlantic City Convention Hall. Frequencies: 10 through 80 meters on General class phone band 25 kHz up from lower end of band. CW 10 through 80 meters, 65 kHz up from bottom of CW General class portion of CW band. A Novice/Technician station is tentatively scheduled on the CW portion of 40 and 15 meters, 50 kHz up from bottom of band. Also a 2 meter station for the Ham community in the immediate Atlantic City area, 146.52 simplex. The call sign for this special event will be K2BR. For a QSL, SASE to SCARA, Box 121, Linwood, NJ 08221.

THE NORTHERN NEW JERSEY CHAPTER OF QCWA has established its "Elmer Award" to honor all the "Elmers" who, since Marconi, have given their time and talent to help others become Amateur Radio operators. The award will consist of two plaques, one carrying the name of each year's winner and rotating annually; the other, a permanent award, naming the current year's winner. Nominations may be made by any licensed Amateur operator in Northern New Jersey. Nominees must be licensed Amateur Radio operators residing in Northern New Jersey. Written nominations should be sent to Carl Felt, N2XJ, 8 Charles Place, Chatham, NJ 07928 prior to September 1, 1982. Presentation of the 1982 award will be made at the Chapter's annual meeting, Friday evening, November 19 at the Robin Hood Inn, Clifton, NJ.

Designing a box
that protects your gear
by keeping the weather out
but letting the rf in

weathering the elements
at 10.4 GHz

Experimenting with 10.4-GHz transceivers can be a lot of fun. But it would be a lot more fun if you could leave your setup on the roof inside a weatherproof enclosure, instead of carrying it up and down the ladder every time you want to operate. This article describes the design of such an enclosure, and also an interesting technique for determining the refractive index at 10.4 GHz of the materials used to build it.

The shape of the enclosure is not important, as long as the one wall of the enclosure through which the 10.4-GHz rf must pass is perpendicular to the direction of rf propagation. The enclosure could simply be a box that is large enough to contain the UHF transceiver and any supporting equipment. The thickness of the enclosure walls, however, and the refractive index (at 10.4 GHz) of the material composing the enclosure walls, are of critical importance. Consider the situation shown in **fig. 1**.

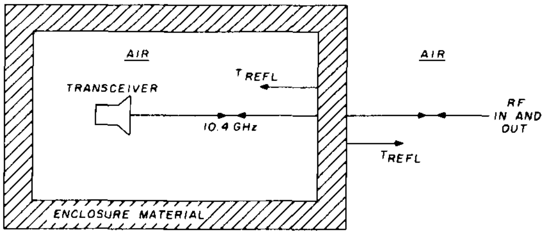


fig. 1. Rf from the transceiver is transmitted through the air inside the enclosure, through the enclosure walls, and then through the air of the outside world. Some of the rf, however, is reflected back into the enclosure. Rf coming from the outside world toward the transceiver experiences the same partial reflection.

By William M. Brooks, WB6YVK, 2050 Southwest Expressway #66, San Jose, California 95126

During transmit, 10.4-GHz waves emanate from the transceiver inside the enclosure, which is filled with air. The radio waves strike the inside wall of the enclosure, a wall composed of polystyrene, nylon, glass, or whatever. The wall will have electromagnetic properties different from those of air. Here is where a problem develops.

When a wave in one medium (such as air) strikes a second medium (the enclosure material) which has a conductivity σ, or permittivity ϵ, and permeability μ, the wave will be partially reflected by the second medium and partially transmitted into it. This partial reflection and partial transmission of the wave occurs because the wave initially propagates in air, with impedance $Z_o = \sqrt{\frac{\mu_o}{\epsilon_o}}$, and then strikes a medium (enclosure material) with impedance $Z_x = \sqrt{\frac{\mu_x}{\epsilon_x}}$.

The reflection coefficient, T_{refl}, can be expressed as:

$$T_{refl} = \frac{Z_x - Z_o}{Z_x + Z_o} \quad (1)$$

where Z_x = the impedance of the unknown material

Z_o = the impedance of air

and the transmission coefficient, T_{trans}, as

$$T_{trans} = \frac{2Z_x}{Z_x + Z_o} \quad (2)$$

No reflection will occur when the electromagnetic impedances of the two media are equal, that is, when $Z_x = Z_o$. If the media are perfect dielectrics, that is, those which have no losses (Z is real), we can define SWR as:

$$SWR = \frac{Z_x}{Z_o} \ if\ Z_x > Z_o \quad (3)$$

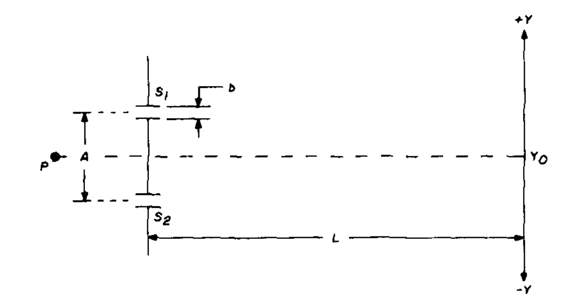


fig. 2. Young's double slit experiment. Slits S1 and S2 act as in-phase radiation sources, resulting in constructive and destructive interference patterns when viewed along axis Y.

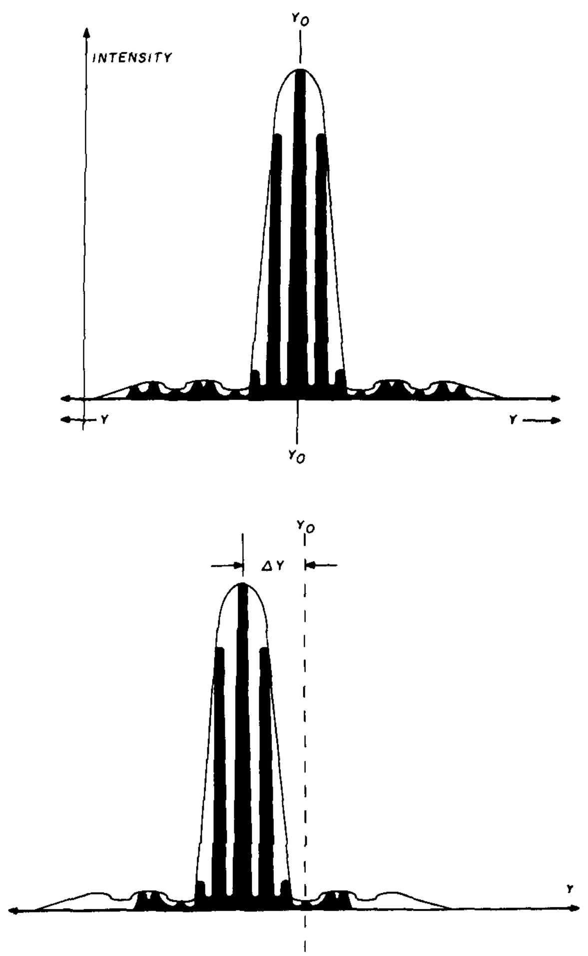


fig. 3. In (A), the intensity envelope seen along axis Y. Maximum intensity is centered at Y_o. In (B), the intensity envelope is seen shifted in the direction of the slit covered by the sample of enclosure material.

$$or\ \frac{Z_o}{Z_x} \ if\ Z_o > Z_x$$

We can eliminate the reflected wave from the air/enclosure-wall interface if we require that the medium outside the enclosure be the same as that inside the enclosure (that is, air inside and outside), and that the wall of the enclosure be $\frac{\lambda}{2}$ thick. The thickness, t_1, of the enclosure walls is then:

$$t_i = \frac{\frac{\lambda}{2}}{\eta_x} \quad (4)$$

where η_x = the refractive index of the material at 10.4 GHz.

To determine the refractive index at 10.4 GHz of the enclosure material, consider Young's double-slit experiment shown in **fig. 2**. A point source radiator is located at P. Waves from P propagate to slits S1 and S2, which act as two in-phase radiation sources that are separated by distance A. These two sources cause constructive and destructive interference along the Y axis when viewed at distance L. The intensity at Y is the result of interference and diffraction, expressed as

$$I_y = I_o \, sinc^2 \left(\frac{\pi b y}{\lambda L}\right) \, 4 \cos^2 \left(\frac{\pi A Y}{\lambda L}\right) \quad \textbf{(5)}$$

where: I_y = intensity at screen along Y
b = slit width
A = slit separation
L = distance from slits to screen
I_o = intensity at Y without slits

The intensity envelope described by **Eq. (5)** is shown in **fig. 3A**. Note that the intensity envelope is symmetrical and centered at Y_o.

Placing a sample of the enclosure material in front of one of the slits causes the two slits to radiate out of phase, because of the difference between the propagation velocity through the material and the velocity through air. The result is a displaced intensity envelope in a direction toward the slit with the sample of enclosure material, as shown in **fig. 3B**. The magnitude of this displacement is related to the thickness, t_2, of the sample and its refractive index, η_x:

$$\eta_x = \frac{\Delta Y}{t_2} \frac{d}{L} + \eta_{air} \quad \textbf{(6)}$$

where η_x = refractive index of the material
η_{air} = refractive index of air (1.000276)
d = center-to-center slit separation
L = distance from slits to Y
t_2 = thickness of the sample

practical example

Suppose that we have acquired some material that looks like polystyrene, but we are not certain that it is polystyrene, nor do we know its refractive index at 10.4 GHz.

To determine the refractive index, we construct a simple double slit mask, as shown in **fig. 4**. It can be constructed of cardboard and then covered with aluminum foil. The double slit mask is placed in front of the 10.4-GHz transmitter, as shown in **fig. 5**.

Let the distance, L, between the slit mask and Y be 2 meters. Moving a suitable detector that gives a strength reading along Y, we will observe the intensity envelope as shown in **fig. 3A**. The envelope should be centered at Y_o. Then, when a sample of the material is placed in front of slit S1 and the experiment repeated, we will observe that the intensity envelope has shifted toward the S1 side of Y, as in **fig. 3B**. The thickness of the sample, t_2, in this instance proved to be 25 mm, and the observed envelope shift, ΔY, was measured 0.51 meter. This reveals a refractive index, η_x, of 1.593, using **Eq. (6)**. We now know the refractive index at 10.4 GHz of the material.

Substituting the determined η_x value into **Eq. 4** reveals that the thickness of the enclosure walls has to be 0.90 cm to behave as a transparent medium for 10.4-GHz rf. Thus, by simply constructing a box of this material with walls 0.90 cm thick, we have prevented rain, sleet, and snow from getting into our transceiver, but we allow 10.4-GHz rf to see an open window.

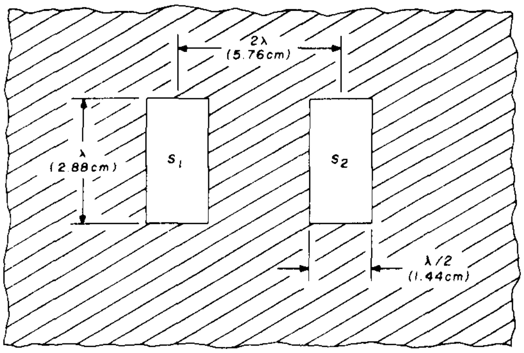


fig. 4. Construction details of the double-slit mask, a device that can be used to determine the refractive index of the material in question. Once the refractive index is known, it is a simple matter to calculate the wall thickness required to make the box appear transparent at 10.4 GHz.

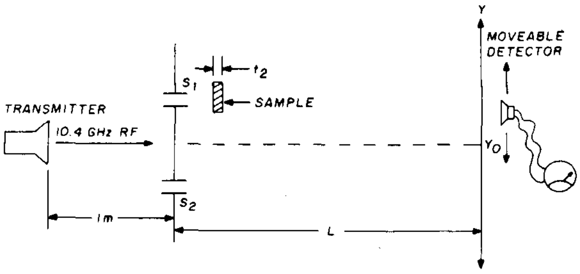


fig. 5. Experimental set-up for determining the refractive index of a sample of the unknown material. Distance between the transmitter and slit mask should be about 1 meter.

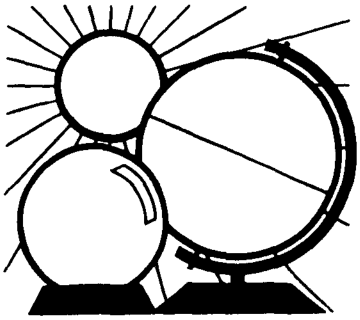
bibliography

Hecht, E., and Zajac, A., *Optics*, Addison-Wesley Publishing Co., Reading, Massachusetts, 1975.

Plonus, M.A., *Applied Electromagnetics*, McGraw-Hill Book Company, New York, 1978.

ham radio

More Details? CHECK—OFF Page 92



DX FORECASTER

Garth Stonehocker, K0RYW

last-minute forecast

The higher frequencies (10 and 20 meter bands) are expected to provide good DX openings during the second and third weeks of the month. The beginning and ending weeks will probably see only fair DX conditions on these bands. Nighttime DX conditions, and openings on the lower frequency bands (40 through 160 meters), should be better during these beginning and ending weeks of the month — particularly the last week, when the nights are longer and the thunderstorm QRN that builds up toward evening has subsided somewhat. Geomagnetically disturbed conditions of two to three days' duration probably could provide interesting and unusual DX about the 6th and 17th.

A more extended period of disturbance, which may be evident about the 24th, may be part of a 27-day recurrent pattern of thinning in the sun's corona. This thinning permits the solar wind to travel through to the earth's polar regions, causing geomagnetic disturbances. At this time in the eleven-year cycle the sun is still active enough to produce a strong solar wind, which may cause repeated disruptions of communications during the two years of 1983 and 1984. From then through the sunspot minimum (1985 and 1986), there should be no geomagnetic disturbances caused by either flares or solar wind. The sun becomes so subdued that nothing happens.

The lunar perigee will be on the 17th and full moon on the 4th this month. The Perseids meteor shower occurs between the 10th and 14th, with maximum the 11th and 12th at better than fifty meteors per hour. This is an excellent shower.

forecasting by computer

In the August, 1981, column, I mentioned that the North Atlantic forecast on WWV is essentially the solar flux and geomagnetic A figure. An analytical mathematical formulation has been developed by Mr. John Harris and me as an aid to our forecasters and observers (monitors). Given the daily flux value and daily A value, a number from zero to nine representing radio quality can be calculated. This number can be a baseline number from which each user can adapt his own calibration for his operating mode (CW, phone, RTTY). Many Amateurs have home computers these days. This formula can be programmed on these computers to obtain a daily propagation quality forecast. The formula is:

$$Q = 10\left[\log\,(\sqrt[4]{\phi})^{\theta}\right]\left[e^{-0.01A}\right] + 0.82$$

where ϕ is the daily solar flux, A is the geomagnetic daily value, and

$$\theta = 1.0 + 0.2625\,\sin^2 0.49315X$$

where X is the annual day number. Try it. If you have any questions, write to me at Rt. 1, Box 36, Earlysville, Virginia 22936.

band-by-band forecast

Ten and fifteen meters should provide excellent daytime openings. The hours of daylight should begin to be noticeably shorter, particularly toward the end of the month. Watch for the best openings during periods of high solar flux. They should be north/south paths to Africa, South America, and the South Pacific, but they will not be of the one-long-hop trans-equatorial (TE) type that correlate well with geomagnetic disturbances. TE paths are usually scarce in July and August. A sun-following sequence of Africa in the morning (local time), South America in the early afternoon and the South Pacific in the late afternoon is usually seen from most QTHs in the U.S.A. *Fifteen* will be open a little before *ten* and will last a little longer in the evening.

Twenty meters will be open around-the-clock on most days, and will be the long-skip/short-skip workhorse of the high-frequency DX bands. Signals will peak in the morning and afternoon hours but will be readable to one area or another all the day and night.

Forty meters is going to start coming back strong, except for the high QRN levels during local thunderstorms. It can often provide good DX from sunset through darkness till just after sunrise, despite the atmospheric noise levels — provided you choose times when local thunderstorms are at a minimum.

Eighty and one-sixty meters will become active once again for DX during the nighttime hours, with strong openings into the south. High QRN levels will still be a problem generally, but the bands will be usable between local thunderstorms.

ham radio

AUGUST

WESTERN USA

GMT	PDT	ASIA FAR EAST (N)	EUROPE (NE)	S. AFRICA (E)	S. AMERICA (SE)	ANTARCTICA (S)	NEW ZEALAND (SW)	OCEANIA AUSTRALIA (W)	JAPAN (NW)
0000	5:00	15	—	20	15	—	10	10	15
0100	6:00	15	—	20	15	—	10	10	15
0200	7:00	15	—	20	15	15	10	10	15
0300	8:00	15	—	20	15	15	10	10	15
0400	9:00	15	—	20	20*	15	10	10	15
0500	10:00	20	—	20	20	20	15	15	15
0600	11:00	20	—	20	20	20	15	15	20
0700	12:00	—	—	20	20	20	15	15	20
0800	1:00	—	—	20	20	20	15	15	20
0900	2:00	—	—	—	—	20	20	15	20
1000	3:00	—	—	—	—	—	20	15	20
1100	4:00	—	—	—	—	—	20	20	40
1200	5:00	—	—	—	—	—	40	20	40
1300	6:00	—	20	—	—	—	40	20	40
1400	7:00	20	20	—	—	—	20	20	40
1500	8:00	20	20	15	—	—	20	20	20
1600	9:00	20	20	15	15	20	—	20	20
1700	10:00	20	15	15	10	15	—	—	20
1800	11:00	15	15	15	10	15	—	—	—
1900	12:00	15	15	15	10	15	10	—	—
2000	1:00	20	15	15	15	15	10	—	—
2100	2:00	—	20	15	15	15	10	10	15
2200	3:00	—	20	20	15	15	10	10	15
2300	4:00	—	20	20	15	—	10	10	15

MID USA

GMT	MDT	ASIA FAR EAST (N)	EUROPE (NE)	S. AFRICA (E)	S. AMERICA (SE)	ANTARCTICA (S)	NEW ZEALAND (SW)	OCEANIA AUSTRALIA (W)	JAPAN (NW)	CDT
0000	6:00	15	20	20	15	—	10	10	15	7:00
0100	7:00	15	20	20*	15	—	10	15	15	8:00
0200	8:00	20	20	20	15	15	10	15	15	9:00
0300	9:00	20	20	20	20	15	15	15	15	10:00
0400	10:00	20	20	20	20	20	15	15	20	11:00
0500	11:00	20	20	20	20	20	15	15	20	12:00
0600	12:00	20	20	20	20	20	15	20	20	1:00
0700	1:00	20	20	—	20	20	20	20	20	2:00
0800	2:00	20	—	—	20	20	20	20	40*	3:00
0900	3:00	—	—	—	20	20	20	20	40	4:00
1000	4:00	—	—	—	—	—	20	20	—	5:00
1100	5:00	—	20	—	—	—	20	20	—	6:00
1200	6:00	—	20	—	—	—	20	20	—	7:00
1300	7:00	—	20	15	—	—	20	20	—	8:00
1400	8:00	—	20	15	10	—	20	20	—	9:00
1500	9:00	20	20	15	10	—	—	20	—	10:00
1600	10:00	20	15	15	10	—	—	—	—	11:00
1700	11:00	20	15	15	10	—	—	—	—	12:00
1800	12:00	15	15	15	10	15	—	—	—	1:00
1900	1:00	15	15	15	10	15	10	—	—	2:00
2000	2:00	20	15	15	10	15	10	—	15	3:00
2100	3:00	20	20	15	10	15	10	10	15	4:00
2200	4:00	20	20	15	10	15	10	10	15	5:00
2300	5:00	—	20	20	10	15	10	10	15	6:00

EASTERN USA

GMT	EDT	ASIA FAR EAST (N)	EUROPE (NE)	S. AFRICA (E)	CARIBBEAN S. AMERICA (SE)	ANTARCTICA (S)	NEW ZEALAND (SW)	OCEANIA AUSTRALIA (W)	JAPAN (NW)
0000	8:00	15	20	20	15	20	15	15	15
0100	9:00	20	20	20	15	20	15	15	20
0200	10:00	20	20	20	15	20	15	15	20
0300	11:00	20	20	20	15	20	20	20*	20
0400	12:00	20	40	20	20	20	20	20	20
0500	1:00	20	40	20	20	20	20	20	20
0600	2:00	20	40	—	20	20	20	20	20
0700	3:00	—	—	—	20	20	20	20	20
0800	4:00	—	—	—	20	20	20	20	—
0900	5:00	—	—	—	20	—	40*	20	—
1000	6:00	—	—	—	20	—	40*	20	—
1100	7:00	—	20	—	—	—	40	20	—
1200	8:00	—	20	15	15	—	20	20	—
1300	9:00	20	15	15	10	—	20	20	—
1400	10:00	20	15	15	10	—	—	20	—
1500	11:00	20	15	15	10	20	—	20	—
1600	12:00	20	15	15*	10	20	—	—	—
1700	1:00	20	15	15*	10	15	—	—	—
1800	2:00	15	15	15	10	15	—	—	—
1900	3:00	—	15	15	10	15	—	—	—
2000	4:00	—	20*	15	10	15*	15	—	—
2100	5:00	—	20	15	10	15	10	15	20
2200	6:00	15	20	20	15	15	10	15*	15
2300	7:00	15	20	20	15	15	15*	15	15

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6LQ6/6JE6	6.00
6MJ6/6LQ6/6JE6C	10.00
6LF6/6MH6	6.60
12BY7A	4.00
2E26	4.69
4X150A	29.99
4CX250B	68.00
4CX250R	78.00
4CX300A	109.99
4CX350A/8321	100.00
4CX350F/J/8904	100.00
4CX1500B/8660	300.00
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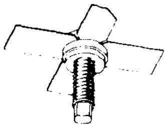
8908	14.00
8950	13.00
4-400A	145.00
4-400C	145.00
572B/T160L	44.00
7289	39.99
3-1000Z	229.00
3-500Z	141.00

RF Transistors



MRF203	P.O.R.
MRF216	31.00
MRF221	10.90
MRF226	12.65
MRF227	3.45
MRF238	12.65
MRF240	19.90
MRF245	34.00
MRF247	34.00
MRF262	9.20
MRF406	13.80
MRF412	25.30
MRF421	36.80
MRF422A	41.40
MRF422	41.40
MRF428	46.00
MRF428A	46.00
MRF426	15.50
MRF426A	15.50
MRF449	12.65
MRF449A	12.65
MRF450	13.80
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MRF452	15.00
MRF453/GE282	17.25
MRF454	19.90
MRF454A	21.83
MRF455	16.00
MRF455A	16.00
MRF458	19.90
MRF472	1.00
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MRF475	4.90
MRF476/C1306	2.90
MRF477	11.50
MRF485	3.00
MRF492	23.00
MRF502	1.04
MRF604	2.07
MRF629	3.45
MRF648	33.35
MRF901	2.15
MRF902	8.00
MRF904	3.00
MRF911	3.00
MRF8004	2.10
BFR90	1.30
BFR91	1.65
BFR96	2.20
BFW92A	1.15
BFW92	1.00
MMCM918	14.30
MMCM2222	15.65
MMCM2369	15.00
MMCM2484	15.25
MMCM3960A	24.30
MWA120	9.80
MWA130	9.80
MWA210	8.80
MWA220	9.08
MWA230	9.80
MWA310	8.80

Transistors

2N2857	1.55
2N2857JAN	2.50
2N2949	3.60
2N2947	15.00
2N2950	4.60
2N3375	8.00
2N3553	1.90
2N3818	5.00
2N3866	1.30
2N3866JAN	2.50
2N3866JANTX	4.00
2N3925	10.00
2N3948	2.00
2N3950	25.00
2N3959	3.85
2N3960JANTX	10.00
2N4072	1.80
2N4427	1.30
2N4429	7.00
2N4877	1.00
2N4959	2.30
2N4976	15.00
2N5070	18.40
2N5071	20.70
2N5108	4.00
2N5109	1.70
2N5179	.69
2N5583	4.00
2N5589	8.65
2N5590	10.35
2N5591	13.80
2N5635	10.35
2N5636	12.00
2N5637	15.50
2N5641	9.20
2N5643	15.50
2N5645	13.80
2N5842	8.00
2N5849	20.00
2N5942	40.00
2N5946	19.00
2N5862	57.50
2N6080	9.20
2N6081	10.35
2N6082	11.50
2N6083	10.00
2N6084	15.00
2N6095	12.00
2N6096	15.50
2N6097	17.25
2N6166	40.25
2N6368	28.75
A210/MRF517	2.00
BLY38	5.00
40280/2N4427	1.30
40281/2N3920	7.00
40282/2N3927	17.25
MMT-74	1.04

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MC4000P	5.09
MC4000L	7.30
MC4001P	9.60
MC4002P	4.96
MC4002L	7.30
MC4006P	5.99
MC4006L	8.33
MC4007L	8.43
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MC4012P/74412P	7.16
MC4012L	9.55
MC4015P/74415P	5.81
MC4015L/74415L	8.25
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MC4017P/74417P	6.89
MC4018P/74418P	6.89
MC4018L/74418L	10.05
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MC4019L/74419L	10.05
MC4022P	5.41
MC4023P	7.79
MC4024P	3.00
MC4044P	3.00
MC4050P/74450P	12.25
MC4060P	5.32
MC4062P	3.43
MC4000F	8.87
MC4006F	8.33
MC4007F	8.43
MC4008F	6.16
MC4060F/74460F	7.57
MC4062F	7.00
MC4300C	8.20
MC4306L	9.05
MC4307L	11.09
MC4312L	10.67
MC4318L/MC54148L	11.40
MC4322L	8.61
MC4350L/MC54450L	17.16
MC4300F	10.00
MC4307F	10.99
MC4316F	13.55
MC4322F	10.40
MC4323F	13.87
MC4350F	20.89
MC4362F	7.75
MC1303L	1.00
MC1306	1.27
MC1311	3.00
MC1330	2.50
MC1350	2.50
MC1351	1.43
MC1352	1.37
MC1358	2.50
MC1359	3.00
MC1393	1.76
MC1408L6	2.75
MC1414L	1.83
MC1414P	1.29
MC1435L	2.25
MC1436G	4.40
MC1437	2.25
MC1439	3.57
MC1461	
MC1468L	5.33
MC1469R	5.65
MC1496P	2.50
MC1511G	12.00
MC1535G	18.19
MC1539G	5.40
MC1550G	1.00
MC1552G	11.61
MC1558L	1.68
MC1560R	16.25
MC1569RB2	10.49
MC1590G	6.00
MC1709CG	.97
MC1710G	1.79
MC1711CL	1.03
MC1712CP	3.35
MC1723CP	.67
MC1733CL	1.35
MC1741G	1.50
MC14528B	2.04
MC14530BCP	1.22
LM101AH	2.40
LM108AH	8.83
LM111H	8.73
LM139A	12.13
LM202H	9.00

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LM211	4.43
LM258	2.15
LM270	7.55
LM301AP/H	.69
LM304H	1.20
LM307N	.55
LM308H	1.00
LM310H	1.10
LM311V	.89
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LM319N	1.25
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LM1391N	1.17
LM1458V	.59
LM1514J	4.98
LM1889	6.70
LM2901/SL61638	1.39
LM3900/CA3401	.84
LM4250CH	1.84
CA3011	1.97
CA3046	1.30
CA3085	.98
CA3086	1.04
CA3140	1.24
LM3146	2.00

Series 74S

74S00	.59
74S02	.59
74S03	.59
74S04	.59
74S05	.59
74S08	.79
74S10	.59
74S11	.59
74S20	.59
74S22	.69
74S30	.59
74S37	.99
74S38	.99
74S40	.69
74S64	.89
74S65	.89
74S74	1.49
74S83	1.75
74S86	1.69
74S112	1.39
74S114	1.39
74S124	3.75
74S133	.89
74S134	1.90
74S138	3.95
74S139	3.95
74S140	1.29
74S151	1.95
74S153	2.75

IC'S

74S157	2.70
74S158	2.70
74S163	3.75
74S164	2.75
74S174	3.75
74S175	3.75
74S181	9.50
74S189	6.95
74S194	3.25
74S195	2.99
74S200	8.95
74S240	8.95
74S241	8.95
74S251	2.49
74S257	2.49
74S260	.99
74S280	3.95
74S283	4.70
74S287	3.95
74S373	3.49
74S374	3.49
74S474	9.00
Series 74	
7400	.39
7401	.49
7402	.27
7403	.27
7404	.27
7405	.28
7406	.28
7407	.28
7408	.31
7409	.28
7410	.27
7411	.34
7412	.34
7413	.44
7414	.90
7416	.34
7417	.34
7420	.27
7423	.34
7425	.34
7426	.34
7427	.34
7428	.34
7430	.28
7432	.34
7433	.34
7437	.34
7438	.34
7439	.39
7440	.29
7441	.99
7442	.99
7443	.99
7445	.99
7446	.99
7448	.84
7449	.99
7450	.28
7451	.28
7453	.28
7454	.28
7460	.44
7470	.39
7472	.42
7473	.41
7474	.42
7475	.42
7476	.42
7480	.64
7483	.60
7485	.70
7486	.44
7489	1.80
7490	.99
7491	.70
7492	.77
7493	.54
7494	.77
7495	.70
7496	.77
7497	.77
74100	1.04
74105	.37
74107	.58
74109	.37

74116	2.30
74120	2.00
74122	.64
74123	.64
74125	.49
74126	.62
74132	.74
74141	.74
74145	.67
74148	1.25
74150	1.04
74153	.72
74154	1.24
74155	.87
74157	.74
74158	1.70
74161	1.00
74163	.92
74164	1.02
74165	1.02
74166	1.25
74172	6.00
74173	.84
74174	.94
74175	.94
74177	.90
74180	.80
74181	1.80
74182	.80
74185	2.00
74186	10.00
74190	1.20
74191	1.20
74193	.90
74194	.90
74195	.90
74196	.90
74197	.90
74273	1.10
74279	.84
74283	2.20
74298	3.22
74366	.73
74367	.84
74368	.84
Series 74LS	
74LS00	.40
74LS01	.33
74LS02	.33
74LS04	.44
74LS05	.33
74LS08	.44
74LS09	.43
74LS10	.33
74LS11	.44
74LS14	1.30
74LS20	.31
74LS21	.43
74LS27	.44
74LS30	.31
74LS32	.44
74LS37	.84
74LS38	.44
74LS42	.84
74LS49	1.43
74LS51	.31
74LS54	.40
74LS73	.50
74LS74	.64
74LS75	.73
74LS76	.50
74LS85	1.24
74LS86	.50
74LS90	.80
74LS93	.80
74LS95	.93
74LS96	1.03
74LS107	.50
74LS109	.50
74LS112	.64
74LS123	1.24
74LS125	.94
74LS132	.84
74LS138	.94
74LS139	.68
74LS145	1.30
74LS151	.84
74LS153	.84

74LS155	1.24
74LS156	1.04
74LS157	1.04
74LS158	.80
74LS160	1.03
74LS161	1.20
74LS163	1.03
74LS164	.94
74LS165	.94
74LS173	.94
74LS174	1.04
74LS175	1.04
74LS181	2.25
74LS191	1.20
74LS193	1.03
74LS194	1.20
74LS195	1.00
74LS196	.94
74LS197	.94
74LS221	1.54
74LS240	3.04
74LS244	3.00
74LS245	8.95
74LS251	1.84
74LS253	1.03
74LS257	1.03
74LS258	1.03
74LS259	3.00
74LS266	.64
74LS273	1.80
74LS282	2.10
74LS283	1.15
74LS293	2.00
74LS298	1.34
74LS323	4.79
74LS353	1.70
74LS366	1.04
74LS367	1.04
74LS368	1.04
74LS373	2.80
74LS374	2.80
74LS378	1.33
74LS393	2.00
74LS670	2.34
4001	.34
4002	.34
4007	.34
4009	.64
4011	.34
4012	.34
4013	.54
4015	1.44
4017	1.24
4021	1.54
4023	.42
4024	.84
4025	.43
4027	.84
4028	1.04
4029	1.34
4030	.74
4040	1.34
4046	2.30
4049	.74
4050	.74
4052	1.15
4060	1.44
4069	.44
4081	.40
4093	1.04
7520L	1.35
75107	.84
75108	.84
75113	2.25
75115	
75123/8T23	1.49
75151	
75154	2.00
75350	
75368	2.95
75369	
75427	
75451	2.10
75452	2.10
75454	2.10
75480	
75492	.93

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RCA CA3028A .... $1.00 each
Cascade Amplifier. DC-500 MHz

Analog Devices AD580 IC......... $1.00 each
Low drift voltage reference.
3-terminal device: V. out= 2.5 V ± 1%
4.5 V < V. in < 30 V

MEM 631......................... $.50 each
Dual gate MOS Fet
Vds = 25V. Id = 30 mA
Mhos 800(min)

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with RF, AGC, mixer, low current draw.

Microwave Pin Switching Diodes
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MRF511
1500 MHz, 7.3 dB noise at 200 MHz
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900 MHz, 4.5 dB noise at 200 MHz
Sale price at...................... $.69 each

MEM 712 Fet $1.00

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MC1590G .... $6.00 each
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RF-IF Amp.

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Elpac Paper Caps................ $1.69 each
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to 10 GHz, 5000 pF 200 VDC

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Min. attenuation: 50 dB from 100 MHz
to 10 GHz, 5500 pF 200 VDC

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1/2"H x 1 3/4"L x 1 1/4"W

New High Voltage Oil Filled Capacitor
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53.3 MFD, 3.5 KVDC, Length - 4 1/2",
width - 3 3/4", height - 11"
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Dip Tantalum Capacitors
15 MFD @ 25 VDC................. 7/$1.00

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6.8pF	47pF	13pF	240pF
8.2pF	62pF	14pF	360pF
10pF	160pF	20pF	470pF
12pF	180pF	24pF	1000pF

-350V $1.00 each

TRIMMER CAPS

Sprague, Stable Polypropylene.
.50 each or 10/4.00
not sold mixed

1.2 to 13pF	3.9 to 40pF
2 to 30pF	3.9 to 55pF
3.9 to 18pF	

MOTOROLA RF MODULES

MHW 591
1 to 250 MHz frequency range, 35/36.5 dB gain, 13.6 VDC input, 700/100 output level
1 dB compression, 5 dB noise @ 250 MHz.

MHW592
1 to 250 MHz frequency range, 34.5/36 dB gain, 24 VDC input, 900/100 output level
1 dB compression, 5 dB noise @ 250 MHz.

MRF450 & MRF450A............ $13.80 each
4 Watts input, 50 Watts output,
11 dB gain, 13.6 VDC.

BFR91.......................... $1.65 each
5000 MHz
1.9 noise @ 500 MHz
16 dB gain @ 500 MHz

MRF901 .... $2.15 each
4500 MHz
2.0 noise @ 1000 MHz
10 dB gain @ 1000 MHz

MHW252 .... $39.99 each
.3 Watts input power
25 Watts output power
144-148 MHz, 19.2 Gp power gain
13.6 VDC input

MHW 612A .... $39.99 each
.2 Watts input power
20 Watts output power
146-174 MHz, 20 Gp power gain
12.5 VDC input

AIR VARIABLE CAPACITORS

.1- 10pF	189-6-1	1.50
.5- 12pF	160-107-16	1.50
.9- 15pF		1.50
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1.3- 6.7pF	189-502-4	1.50
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1.8- 9.2pF	189-509-105	1.50
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1.8-16.7pF	189-506-103	1.50
2-19.3pF	189-507-105	1.50
2.1-22.9pF	189-509-5	1.50
2.2- 34pF	193-10-104	1.50
2.2- 34pF	193-10-6, 3/16"x3" shaft	2.50
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3- 105pF	1000 VDC, 1/4"x6" shaft	4.99

HIGH VOLTAGE CAPS.

22 MFD	@ 500 VDC	$1.69
150 MFD	@ 450 VDC	$3.29
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600 MFD	@ 360 VDC	
800 MFD	@ 360 VDC	$2.99
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2000 MFD	@ 350 VDC	$7.99 each
2000 MFD	@ 450 VDC	$22.99 each
3200 MFD	@ 350 VDC	$9.99 each
3100 MFD	@ 450 VDC	$29.99 each
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# 304	100- 550pF	$1.50
# 400	.9- 7pF	$1.00
# 402	1.5- 20pF	$1.00
# 404	8- 60pF	$1.00
# 405	5- 80pF	$1.00
# 420	1- 12pF	$1.00
# 422	4- 40pF	$1.00
# 423	7- 100pF	$1.00
# 426	37- 250pF	$1.00
# 429	80- 300pF	$1.00
# 464	25- 200pF	$1.00
# 465	50- 380pF	$1.00
# 467	110- 580pF	$1.00
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#4615	390-1400pF	$2.00

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more capacitors

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Solder Type 5 $1.99

3pF	47pF	1000pF
20pF	82pF	2000pF
27pF	100pF	

Stud Mount - 1.5 KV............... $1.99 ea.
.01uF, 1000pF, 2200pF

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100 pF @ 5 KV........................ $3.99
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680 pF @ 6 KV........................ $1.99
800 pF @ 15 KV....................... $3.99

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.001 uF @ 10 KVDC .... .89
.001 uF @ 2 KV............... 4/1.00
.0015 uF @ 3 KV.............. 3/1.00
.01 uF @ 4 KV................. .79
.01 uF @ 1.6 KV.............. 4/1.00
.01 uF @ 1 KV.............. 6/1.00
.05 uF @ 3 KV Electro-cube 3.99
.1 uF @ 2 KV Electro-cube 3.99

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.033 pF	8.2 pF	47 pF
.047 pF	10 pF	51 pF
.068 pF	11 pF	56 pF
.01 pF	12 pF	62 pF
.3 pF	13 pF	58 pF
1 pF	15 pF	75 pF
1.2 pF	16 pF	82 pF
1.5 pF	20 pF	91 pF
1.8 pF	22 pF	100 pF
2.2 pF	24 pF	150 pF
2.7 pF	27 pF	300 pF
3.3 pF	30 pF	330 pF
3.9 pF	33 pF	1000 pF
4.7 pF	36 pF	1200 pF
5.6 pF	39 pF	1500 pF
6.8 pF	43 pF	1800 pF

PISTON TRIMMERS

.5 - 10 pF... LRC 682418........... $1.99
.5 - 7.5 pF........... 2.99 ea. or 10/20.00
2 - 27 pF.......................... $2.99
.6 - 6 pF... SFD VCJ2819A $1.99
1 - 3 pF... SFD VCJ2281 .... $1.99
.5 - 12 pF... PCB mount $2.99
1 - 8 pF... SFD VCJ988 .... $1.50
SFD VCJ1983 .... $2.99
.8 - 12 pF... SGE7906.............. $1.99
.8 - 18 pF... 567-013 .... $2.99
.5 - 10 pF... PCB mount $1.29
1.2 - 10 pF... PCB mount $1.00
.2 - 1.5 pF... with 100 pF lap $1.99
.5 - 12 pF... PCB mount $2.99
.5 - 10 pF.......................... $1.99
.5 - 7.5 pF............2.99 ea. or 10/20.00
2 - 27 pF.......................... $2.99
.6 - 6 pF... SFD VCJ2819A $1.99
1 - 3 pF... SFD VCJ2881 .... $1.99

Miniature Ceramic Trimmers
.50 each or 10/$4.00

CV31D350	2 to 8 pF
HM00-4075-03	3.5 to 11 pF
300425	3.5 to 13 pF
E5-25A	5 to 25 pF
	5.1 to 40 pF
	3.5 to 15 pF
	5.2 to 40 pF
	2.5 to 6 pF

PANEL METERS

RF Power output 0-1000 scale
1 MA movement $5.99 ea.

Large 8" scale meter
50 MV movement $6.99 ea.

DC amp meter 0-1 Amp
#2MAS-DAA-001 $4.99 ea.

DC MA meter 0-5 MA
Emico $2.99 ea.

3 assorted 50 uA meter movements, one each: zero center, linear display, and signal strength 3/$8.99

CERAMIC COIL FORMS

CAMBION WITH SLUGS

LST-P/530-2020-03 .... $1.50
3/16"d x 1/2", 20-50 MHz
Green slug with hardware.

LST-H/530-1532-01 .... $1.50
3/16"d x 1/2", 1-20 MHz
Red slug with hardware.

LS6-E/530-1535-02 .... $1.50
1/4" x 3/4", 1-20 MHz
Red slug with hardware.

LST-H/530-2020-02 .... $1.99
3/16"d x 5/16" with terminals
1-20 MHz, red slug

PLST-1 530-1532-01 .... $1.99
3/16"d x 5/16" with terminals
.2-1.5 MHz

PLS5-B - 2 Cyl., 1-20 MHz $1.99
3/8"dia. x 5/8" with terminals and hardware, red slug

PLS5-C - 2 Cyl., .2-1.5 MHz $1.99
3/8" dia. x 5/8" with terminals
yellow slug

LST-1 - Yellow slug, .2-1.5 MHz...... $1.99

CERAMIC COIL FORMS - No Slug

#1......... 3/16" x 5/8" 1.00
#2......... 3/16" x 1/2" 1.00
#3......... 1/4" x 5/8" 1.00
#4......... 3/8" x 1" 1.00
#5......... 1/2" x 1 1/2" 1.00

PAPER COIL FORMS - With Slug

#6......... 1/4" x 3/4"............... 1.00
#7......... 3/16" x 3/4" 1.00

VHF/UHF/MICROWAVE COMPONENTS

J-Fet #J310 .... 3/$1.00
N-Channel, 450 MHz. Good for UHF/VHF amplifiers, oscillator and mixers.

2N6083 .... $10.00 ea.
8.1 Watts input, 30 Watts output.
5.7 dB gain, 12.5 VDC

Motorola RF Amp. Modules......... $29.99 ea.
#544-4001-002
Similar to type MHW401-2
1.5 Watts output, .047 Watts input.
440-512 MHz, 15 dB gain, 7.5 VDC

TRW CA602, CA 2601BV .... $29.99 ea.
Microelectronics Broadband Amp.
15 to 270 MHz, 30 dB gain max.
30 VDC supply voltage

New Microwave Diode
Microwave Associates, Inc. - MA41482 and MA41482R, 10 GHz to 40 GHz

DIODES

1N4148/1N914
Switching diode
30/$1.00 or 100/$3.00

HEP 170
2.5 A, 1000 PIV
.20 ea., 100 for $15.00

HVK 1153
25 mA, 20,000 PIV
$1.00 ea., 10 for $8.00

Motorola MA 752 Rectifier
6 Amps, 200 PIV
4/$1.00

High-voltage diode EK500
5000 Volts, 50 mA
2/.99 each

DG-1005
1.5 A, 1000 PIV
.15 ea., 100 for $12.00

SCMS 10K
15 mA, 10,000 PIV
$1.69 ea., 10 for $12.50

Fairchild LEDs
FLV 5007 & 5009 red.
Case type TO-92.
6/$1.00

Motorola SCR
TO-92 Case, 0.8 Amp, 30 V.
Igt 0.2 Vgt 0.8.
Same as 2N5060.
4/$1.00 or 100/$15.00

10 KV at 1.5 Amps $3.99
High Voltage Diode

CRYSTALS

$3.00 each

5.120	10.010	11.855
7.3435	10.020	11.900
7.4585	10.030	11.905
7.4615	10.040	11.955
7.4625	10.0525	12.000
7.4665	10.130	12.050
7.4685	10.140	12.100
7.4715	10.150	16.965
7.4725	10.160	17.015
7.4765	10.170	17.065
7.4785	10.180	17.165
7.4815	10.240	17.215
7.4825	10.245	17.265
7.4865	10.595	17.315
7.4925	10.605	17.355
7.4985	10.615	17.365
7.5015	10.625	37.600
7.5025	10.635	37.650
7.5065	11.155	37.700
7.7985	11.275	37.750
7.8025	11.700	37.800
9.545	11.705	37.850
9.555	11.730	37.900
9.565	11.750	37.950
9.575	11.755	38.000
9.585	11.800	60.000
10.000	11.850	

CRYSTAL FILTERS

EFCL455K13E	3.99
EFCL455K40B2	2.99
FX-07800L, 7.8 MHz	12.99
FHA103-4, 10.7 MHz	12.99

ORDERING INSTRUCTIONS

Check, money order, or credit cards welcome. (Master Charge and VISA only.) No personal checks or certified personal checks for foreign countries accepted. Money order or cashiers check in U.S. funds only. Letters of credit are not acceptable.

Minimum shipping by UPS is $2.35 with insurance. Please allow extra shipping charges for heavy or long items.

All parts returned due to customer error or decision will be subject to a 15% restock charge. If we are out of an item ordered, we will try to replace it with an equal or better part unless you specify not to, or we will back order the item, or refund your money.

PRICES ARE SUBJECT TO CHANGE WITHOUT NOTICE. Prices supersede all previously published. Some items offered are limited to small quantities and are subject to prior sale.

We now have a toll free number, but we ask that it be used for *charge orders only*. If you have any questions please use our other number. We are open from 8:00 a.m. - 5:00 p.m. Monday thru Saturday.

Our toll free number for charge orders only is 800-528-3611.

MINIMUM ORDER $10.00

NEW products

IC-730 HF transceiver

ICOM announces the IC-730 compact solid state high-frequency transceiver. The IC-730 is specifically designed for the budget-minded ham. It's priced at $829.00, making it affordable as a second transceiver for mobile/portable operation, or as the main high-frequency base station transceiver.

The IC-730 is compact, only 9.5 × 3.7 × 10.8 inches. It has 10-80-meter frequency coverage including all three new WARC bands; it has fully synthesized tuning for stability in mobile operation (1 kHz, 100 Hz, 10 Hz steps). Other features include dual VFOs standard; eight-frequency memory storage (one frequency per

band); fully solid-state circuitry with automatic final protection; and i-f shift standard with passband tuning optional.

For more information, write ICOM, 2112 116th Avenue, Bellevue, Washington 98004.

CW89 software package

Hams who own Heath computers can send and receive Morse code with the new CW89 software package from Commsoft. This program includes a split screen display, 4-99 WPM operation, receive autotrack, a 1000-character pretype buffer, ten user-definable messages, unique break-in mode, on-screen system status, disk I/O, hard copy, and a versatile code practice section.

The CW89 allows the user to practice code at variable speeds in several formats: alphabet only, alphabet and numbers, or all common Morse characters with or without random spaces. Practice code can come from one of one hundred disk files that can be prepared using a standard text editor. All communications and practice texts can be sent to a printer or stored on disk. The CW89 program runs on the Heath H-8/H-19, H-89 or Zenith Z-89 computers under HDOS. One disk drive and 32K RAM are required. A hardware interface, such as the Commsoft Codem, is also required.

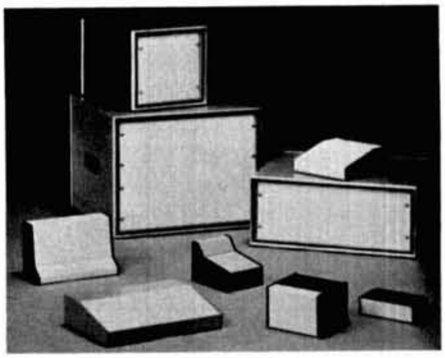
The price of the CW89 is $99.95, postpaid. A complete package consisting of CW89, the Codem, a computer interconnect cable, power supply, complete documentation, and shipping is available for $249.95. California residents add applicable sales tax. VISA and MasterCard orders accepted.

For more information, contact Commsoft, 665 Maybell Avenue, Palo Alto, California 94306; telephone 415-493-2184.

Ten-Tec enclosures

Ten-Tec, Inc., announces a newly expanded enclosure line. The new models include high-style concepts in metal and metal-plastic combinations in larger bench and portable sizes.

The new series 9 and 19 metal cabinets accept panel heights from 3.5 inches up to 17.5 inches, and widths of 9.5 inches and 19 inches. Depths are 14.4 inches and 18.4 inches. Thirteen sizes are standard. Construction is welded aluminum. Standard rack panel mounting rails are provided at both front and back with interior racks for guide rails. Recessed side handles are provided in larger cabinets; smaller sizes use collapsible top handles. Styling features extruded aluminum front and rear edge bezels with walnut or black trim inserts. Standard textured finishes include blue, orange, black and dark brown. Optional front panels are offered in a variety of sizes with custom finishes. Special sizes, finishes and panel punching is available.



The new series S, H, and V use both metal and metal/plastic combinations featuring sloping front panels for keyboard and switch cluster configurations. Series S has 3-inch heights and four widths from 6.5 to 14 inches. Depths are 9 inches. The all-aluminum cabinets are available in standard textured finishes of blue or black with satin-aluminum or beige panels. Series H and V have metal chassis and plastic sides in walnut or black textured finish. All three in this group have sloped and upright front panels.

For complete information, contact Ten-Tec, Inc., Highway 411 East, Seiverville, Tennessee 37862; phone 800-251-9350.

West-Coast repeater directory

The new all-band 1982 VHF/UHF repeater directory is available from Gordon West, WB6NOA. Over seven hundred repeaters in California, Mexico, Arizona, Nevada, and Hawaii are listed in easy-to-read type in this twenty-page repeater log. Repeaters on 10 meters, 6 meters, 2 meters, 220 MHz, and 450 MHz are listed by frequency. The call letters and area of coverage are also noted beside each repeater listing. There are also notes on tones or special functions of each repeater.

Now in its third year of printing and update, this large-format repeater log is the ultimate for accurate and easy-to-understand repeater information. Repeater offsets are given as simply A (+) or (−) to simplify the process of finding the right repeater for your area of operation.

The West-Coast Amateur Radio all-bands repeater log is available at local ham radio stores throughout the southwest. Quantity club and store discounts are also available. Individual copies will be sent out first class mail for $2.50. Write: West Coast Repeater Log, 2414 College Drive, Costa Mesa, California 92626.

Communications Concepts Model 335 fm class-C amplifier kit

Two-meter fm has done more to popularize Amateur Radio than any other mode of communications. In the early days, most hams used surplus commercial two-way transceivers. Then came crystal-controlled transceivers designed specifically for ham use. And now, with advanced CMOS design, you can get a handheld, synthesized radio that will do more than the surplus radios ever could — except for one thing: The new radios all run on significantly less power.

For many hams that isn't a problem at all. But for us here at *ham radio* it's a big problem. In the hills of southern New Hampshire, the small handheld radios simply don't have enough power. Even some of the larger and more powerful radios have trouble from time to time.

There is a way to beat the problem, however, and that is to run an amplifier. Communications Concepts' Model 335 amplifier kit has been designed so that it can be used either at home or in the car. The basic design is class-C, for low power consumption, but provisions have been made to enable you to bias the amplifier class AB, allowing it to be used as an SSB/fm/CW amplifier. The amplifier is quite small and unobtrusive.

Circuit board and materials are all of first-rate quality, and there is very little chance of failure resulting from a defective board or part. An equally important consideration is the excellent instruction booklet. The instructions for assembly are accurate and easy to follow. Since we couldn't devote a whole evening to the project, it was spread out over a span of several nights. There was no problem picking up where we'd left off the night before. That is a real big plus. Construction time was no more than three hours, and the only problem was with the BNC connectors. Our station is set up with UHF connectors throughout, so a few adapters were needed. Not a problem, just a minor inconvenience.

After all the parts were in place, tune-up was relatively simple. The instructions clearly show how it's done, and hints are provided should there be any problems. All that's needed is to adjust input and output capacitors for maximum power.

Placement of the unit is up to the good judgment of the builder. Past experience has taught us that there are several places *not* to put the unit. The first is near the heater output. Many years ago we had another amplifier that failed because of severe overheating, a problem traced to the car's heater. Another good location to avoid is under the seat. Some of the newer cars do not have much clearance, and sliding the seat back and forth can result in tearing the underside. Finally, be careful if you mount the unit on the firewall. We once drilled into the heater core attempting that one. What a mess!

As you would expect, increasing power from 1.5 or 2 watts to 30 increases your radio's capabilities tremendously. We found that in places where accessing a repeater had once been a problem, we were now D.F.Q. Communications Concepts Model 335 VHF amplifier is a nice unit for the ham who wants to put something together and at the same time improve his station's performance.

The editors.

This review was written before the new 335 A-K was released. See May, 1982, page 84 ham radio *for the latest version of this amplifier.*

mobile transceiver

Trio-Kenwood Communications announces the new TR-9130 2-meter fm/SSB/CW 25-watt mobile transceiver, with six memory channels, memory scan, automatic band scan, dual digital VFOs, digital display, noise blanker, high/low power switch, amplified AGC, and a host of other quality features. The TR-9130 is available in two versions, with a basic **UP/DOWN** pushbutton microphone or with a sixteen-key autopatch **UP/-DOWN** microphone.

For additional information, contact Trio-Kenwood Communications, P.O. Box 7065, Compton, California 90224.

HERE'S A GIFT IDEA!

How about an attractive **BASEBALL** style cap that has name and call on it. It's the perfect way to keep eyes shaded during Field Day, it gives a jaunty air when worn at Hamfests and it is a great help for friends who have never met to spot names and calls for easy recognition. Great for birthdays, anniversaries, special days, whatever occasion you want it to be.

Hats come in the following colors: **GOLD**, **BLUE**, **RED**, **KELLY GREEN**. Please send call and name (max 6 letters per line). $5.00 plus $1.00 for shipping.

HAM RADIO'S BOOKSTORE
GREENVILLE, N. H. 03048-0489

ORR BOOKS

BEAM ANTENNA HANDBOOK
by Bill Orr, W6SAI

Recommended reading. Commonly asked questions like: What is the best element spacing? Can different yagi antennas be stacked without losing performance? Do monoband beams outperform tribanders? Lots of construction projects, diagrams, and photos. 198 pages. ©1977. 1st edition.

☐**RP-BA** **Softbound $5.95**

SIMPLE LOW-COST WIRE ANTENNAS
by Bill Orr, W6SAI

Learn how to build simple, economical wire antennas. Apartment dwellers take note! Fool your landlord and your neighbors with some of the "invisible" antennas found here. Well diagramed. 192 pages. ©1972.

☐**RP-WA** **Softbound $6.95**

THE RADIO AMATEUR ANTENNA HANDBOOK
by William I. Orr, W6SAI and Stuart Cowan, W2LX

Contains lots of well illustrated construction projects for vertical, long wire, and HF/VHF beam antennas. There is an honest judgment of antenna gain figures, information on the best and worst antenna locations and heights, a long look at the quad vs. the yagi antenna, information on baluns and how to use them, and new information on the popular Sloper and Delta Loop antennas. The text is based on proven data plus practical, on-the-air experience. **The Radio Amateur Antenna Handbook** will make a valuable and often consulted reference. 190 pages. ©1978.

☐**RP-AH** **Softbound $6.95**

ALL ABOUT CUBICAL QUAD ANTENNAS
by Bill Orr, W6SAI

The cubical quad antenna is considered by many to be the best DX antenna because of its simple, lightweight design and high performance. You'll find quad designs for everything from the single element to the multi-element monster quad, plus a new, higher gain expanded quad (X-Q) design. There's a wealth of supplementary data on construction, feeding, tuning, and mounting quad antennas. 112 pages. ©1977.

☐**RP-CQ** **Softbound $5.95**

Please add $1.00 to cover shipping and handling.

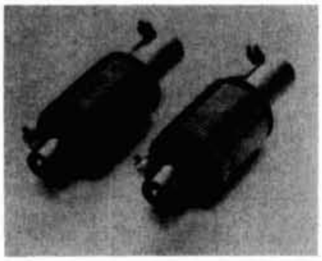
HAM RADIO'S BOOKSTORE
GREENVILLE, NH 03048

UNADILLA/REYCO

HAM products that go the Dx.

Round after round of transmission, durable all-weather UNADILLA/REYCO baluns, traps and kits will take you the distance. Unadilla/Reyco will suppress feedline radiation and maximize antenna efficiency better than any competitive HAM line.

The Big Signal W2AU Balun gives you the right connection between any antenna and transmitter. The W2AU Balun can withstand 600 lbs. of pull, has a built-in lightning arrestor and can handle full legal power. For more than 20 years, it's been the choice of HAMS, Armed Forces and commercial communication around the world.



The Old Reliable W2VS Reyco Trap will always give you the perfect dipole. Professionals demand Reyco Traps because they're weatherized and can withstand 500 lbs. of pull. Developed by veteran HAM W2VS, Reyco Traps are paired by precision frequency.

The W2AU/W2VS 5-band Antenna Kit includes everything for low SWR on 40 and 80 meters, and resonants on 10, 15 and 20. The quality crafted components in this kit are time tested by HAMS around the world.

Other Unadilla/Reyco products include low pass filters, quad parts, insulators and endsulators. Call for our free catalog and the name of your nearest dealer. Hamfest managers: we cooperate. Remember: Unadilla/Reyco will take you the distance.

UNADILLA/REYCO
Division of Microwave Filter Co., Inc.

6743 Kinne St., East Syracuse, NY 13057
Toll Free 1-800-448-1666 **TWX 710-541-0493**
NY/HI/AK/Canada (collect) 1-315-437-3953

FOREIGN HAMS

LONDON: AMCOMM 01 804 1166/**VICTORIA:** Scalar 725 9677/**PUNTA ARENAS:** Novedades Rasmussen 22327/**BUENOS AIRES:** Multi-Radio 773-1266/**COL. ANAHUAC:** Radiac 2-50-32-40/**FRANCE:** SFL (90) 5339 40 (90) 611258

UNADILLA/REYCO
A Division of MICROWAVE FILTER CO., INC.

More Details? CHECK—OFF Page 92

NEW products

desoldering pump

A desoldering pump that can be operated with one hand and without external power has been introduced by the Ungar Division of Eldon Industries. A spring-loaded piston creates a vacuum that instantly removes molten solder. Double O-ring piston-seals achieve maximum vacuum in a piston stroke of less than two inches. The piston is set with the thumb and released by pushbutton for maximum spring force. The worker's other hand is left free to hold the soldering iron that melts the solder.

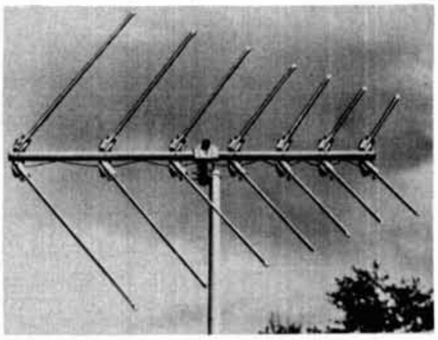
The Ungar 7874 vacuum desoldering pump is made of anodized aluminum and includes a self-cleaning, noclog Teflon tip that is replaceable. The unit is sufficiently reliable, effective and low in static electricity for use in plant assembly or repair operations, and it's small enough to be carried in tool boxes for field use. The list price is only $14.95.

For further information, contact Ungar, 100 W. Manville St., Compton, California 90220; telephone 800-421-1538.

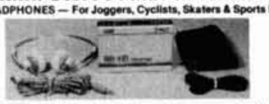
wideband transceiver antenna

Originally designed as a highly directional base station receiving antenna, the Scanner Beam antenna in recent tests has provided forward rf signal radiation of six times transmitter input power. A 10-watt transceiver sounded like a 60-watt base station. Average VSWR throughout the VHF/UHF bands was a low 1.6:1. Because of its highly directional design, forward signal radiation could be "targeted" toward distant repeater or base stations, thereby increasing the range of low-powered handheld transceivers — and all of this without the use of auxiliary power or expensive preamps.

Hams have discovered excellent transmit/receive performance on 144-148, 220-225, and 420-450 MHz. For additional information, write Grove Enterprises, Inc., Dept. D, Brasstown, North Carolina 28902; telephone 704-837-2216. The ANT-1 Scanner Beam antenna may be ordered direct by calling 1-800-438-8155.



UTIC Mini Stereo AM/FM Receiver
WITH HEADPHONES — For Joggers, Cyclists, Skaters & Sports Events



FEATURES: Lightweight headphones. Left/right balance control. Full fidelity stereo sound. Additional black soft carrying case & shoulder strap. Belt clip (hands free). Operates on 3 AA cell batteries (not incl.). Compact size: 3⅛" x 4⅞" x 1". Wt. 6 oz.

Model 2830 List Price $89.95 .... **$34.95**

SPEAKERS

2¼" Round — 8 Ohm .25 Watt (4" Leads) Size: 2¼" x ¾"

Part No. A0201 .... Price $1.25 or 2/1.98

2½" Square — 16 Ohm .25 Watt (4 mount. holes) Large Ceramic Magnet Size: 2⅝" x 2⅝" x ¾"

Part No. SF-25016 . Price $1.39 or 2/2.98

MOTOROLA
AM/FM Stereo Push Button CAR RADIO
FOR VOLKSWAGEN SCIROCCO, RABBIT, AUDI 5000 AND FOX
(with minor adjustments, can be used in any automobile)

Includes bezel trim and everything pictured. Two each 4x6 speakers and grille (1½" deep). All cables and leads for hook-up. Includes all Instruction Manuals for easy installation. Cut-out dimensions: 7"W x 1¾"H x 6½"L.

Model 5VW3901 .... **$49.95**

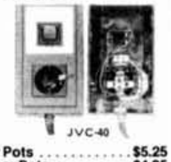
UV-EPROM Eraser

Erases 2708, 2716, 2732, 2764, 2516, 2532, 2564. Erases up to 8 chips within 51 minutes (1 chip in 37 minutes). Maintains constant exposure distance of one inch. Special conductive foam liner eliminates static build-up. Built-in safety lock to prevent UV exposure. Compact — only 9.00" x 3.70" x 2.60". Complete with holding tray for 8 chips.

UVS-11EL Replacement Bulb **$16.95**

DE-4 UV-EPROM Eraser **$79.95**

JOYSTICKS



JS-5K	5K Linear Taper Pots	$5.25
JS-100K	100K Linear Taper Pots	$4.95
JS-150K	150K Linear Taper Pots	$4.75
JVC-40	40K (2) Video Controller in case	$4.95

5¼" Mini-Floppy Disc Drive
Pertec Computer Corp.

FOR TRS-80 MODEL I, III (Industry Standard)

Features single or double density. Recording mode: FM single, MFM double density. Power: +12VDC (±0.6V) 1.6 amps max., 5VDC (±0.25V) 0.8 amps max. Unit as pictured at left (does not incl. case, power supply or cables). 30-page data book included. Weighs 3½ pounds. Size: 5¾"W x 8"D x 3¼"H

Limited Quantity!

Part No.	Price
FD200	$179.95
Single-sided, 40 tracks, 250K bytes capacity	
FD250	$199.95
Double-sided, 35 tracks, 438K bytes capacity	

JE215 Adjustable Dual Power Supply
General Description: The JE215 is a Dual Power Supply with independent adjustable positive and negative output voltages. A separate adjustment for each of the supplies provides the user unlimited applications for IC current voltage requirements. The supply can also be used as a general all-purpose variable power supply.

FEATURES:
- Adjustable regulated power supplies, pos. and neg. 1.2VDC to 15VDC.
- Power Output (each supply): 5VDC @ 500mA, 10VDC @ 750mA, 12VDC @ 500mA, and 15VDC @ 175mA.
- Two, 3-terminal adj. IC regulators with thermal overload protection.
- Heat sink regulator cooling
- LED "on" indicator
- Printed Board Construction
- 120VAC input
- Size: 3-1/2"w x 5-1/16"L x 2"H

JE215 Adj. Dual Power Supply Kit (as shown) .. **$24.95**

(Picture not shown but similar in construction to above)

JE200 Reg. Power Supply Kit (5VDC, 1 amp) .. $14.95

JE205 Adapter Brd. (to JE200) ±5,±9 & ±12V. $12.95

JE210 Var. Pwr. Sply. Kit, 5-15VDC, to 1.5amp. $19.95

KEYBOARDS — POWER SUPPLIES

JE610 ASCII Encoded Keyboard Kit
The JE610 ASCII Keyboard Kit can be interfaced into most any computer system. The kit comes complete with industrial grade keyboard switch assembly (62-keys), IC's, sockets, connector, electronic components and a double-sided printed wiring board. The keyboard assembly requires +5V @ 150mA and −12V @ 10mA for operation. Features: 60 keys generate the 128 characters, upper and lower case ASCII set. Fully buffered. Two user-define keys provided for custom applications. Caps lock for upper-case-only alpha characters. Utilizes a 2376 (40-pin) encoder read-only memory chip. Outputs directly compatible with TTL/DTL or MOS logic arrays. Easy interfacing with a 16-pin dip or 18-pin edge connector. Size: 3⅛"H x 14⅛"W x 8¾"D.

JE610/DTE-AK (After assembly as pictured above) **$124.95**

JE610 Kit 62-Key Keyboard, PC Board & Components (no case) ...... **$ 79.95**

K62 62-Key Keyboard (Keyboard only) .... **$ 34.95**

DTE-AK (case only — 3⅛"H x 11"W x 8¾"D) .... **$ 49.95**

JE212 — Negative 12VDC Adapter Board Kit for JE610 ASCII KEYBOARD KIT
Provides —12VDC from incoming 5VDC **$9.95**

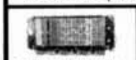
JE600 Hexadecimal Encoder Kit
FULL 8-BIT LATCHED OUTPUT 19-KEY KEYBOARD
The JE600 Encoder Keyboard Kit provides two separate hexadecimal digits produced from sequential key entries to allow direct programming for 8-bit microprocessor or 8-bit memory circuits. Three additional keys are provided for user operations with one having a bistable output available. The outputs are latched and monitored with 9 LED readouts. Also included is a key entry strobe. Features: Full 8-bit latched output for microprocessor use. Debounce circuit provided for all 19 keys. Nine LED readouts to verify entries. Easy interfacing with standard 16-pin IC connector. Only +5VDC required for operation. Size: 3⅛"H x 8⅛"W x 8¾"D.

JE600/DTE-HK (After assembly as pictured above) **$99.95**

JE600 Kit 19-Key Hexadecimal Keyboard, PC Board & Components (no case) **$59.95**

K19 19-Key Keyboard (Keyboard only) **$14.95**

DTE-HK (case only — 3½"H x 8¼"W x 8¾"D) **$44.95**


9½"Lx4¼"Wx1"H

ALPS 26-KEY CALCULATOR KEYBOARD
Gray Key Caps with blue, green and white back drop. Mechanical SPST Switching: 22-pin Edge Card Connection.
Part No. KB26 .... **$2.95 each or 2/$4.95**


16⅞"L x 5¼"W x 1⅞"H

MICRO SWITCH 69-KEY KEYBOARD
Data Entry Keyboard, Encoded Output: 8-bit Parallel EBC DIC. Switching: Hall Effect, 24-pin Edge Card Connection. Complete with Pin Connection.
Part No. KB69SD12-2 .... **$19.95 each**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DATANETICS 74-KEY KEYBOARD
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23"Lx5¾"Wx1-3/8"H

MICRO SWITCH 85-KEY KEYBOARD
Data Entry Keyboard. Switching: Hall Effect, 13-pin Edge Card Connection. Metal frame, dark brown key caps.
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Data Entry Keyboard used in a Diablo 1640 Terminal. Supply Voltage: +5V, -12V. Switching: Hall Effect — 10-pin Edge Card Connection. Schematic included.
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Output +5VDC @ 1 amp (also +30VDC) reg. Input 115VAC 60Hz. Two-tone (black/beige) self-enclosed case. 6 ft., 3 cond. black power cord. Size: 6⅛"W x 7"D x 2⅛"H. Wt. 3 lbs.
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DJ14-2-14	924106-24	14	double end	24"	3.49
DJ14-3-14	924106-36	14	double end	36"	3.79
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DJ16-3	924112-36	16	single end	36"	2.59
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SOC5-25	E	4.25	5.25	25.0	21.5	17.5	16.00x4.88x4.88	16.0	49.95
SOC12-11	E	11.4	12.6	11.0	9.2	6.8	14.00x4.88x1.62	12.0	44.95
SOC12-15	F	11.4	12.6	15.0	12.75	9.5	16.00x4.88x4.88	16.0	49.95
SOC15-5	C	14.25	15.75	5.0	4.2	3.5	7.00x4.88x3.37	6.6	39.95
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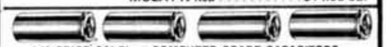

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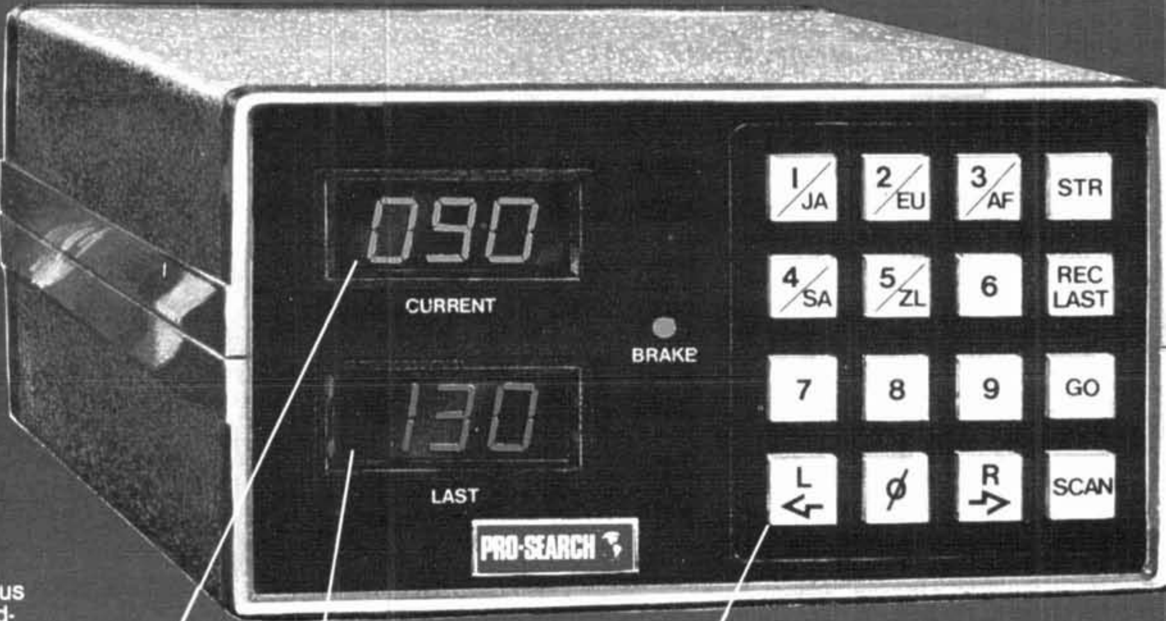

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Pro-Search seeks out a pre-programmed heading, plus stores various common headings and automatically scans for those rare multipliers, giving the operator hands-free operation and more time for contesting.

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Pro-Search loads in short path and long path headings and with the touch of a button, the system works between both headings. Plus you have all of the other features of the Pro-Search to aid you in catching that rare DX station.

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Pro-Search offers ease of operation...control the entire system with just one touch. A talk loop...vocally calls out the headings, allowing blind operators to accurately program and hear their headings.

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Pro-Search **has numerous uses.**
Pre-set beam headings for SKEDS, VHF WORK, and many others. Current headings can be read, by displaying the present directions with LEDS. Pro-Search also displays and stores the last heading worked, which can be recalled by the Auto-Locate system with the touch of a button.

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Pro-Search Is Adaptable To Many Systems, Simple To Install.

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Disconnect your present antenna control system and connect ours.

Pro-Search is presently used with HAM-M, HAM-II, III, IV, and T²X Other models will be available to work with the HDR-300, etc.

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Pro-Search Electronics
A Division of Wurdack and Associates, Inc.
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St. Louis, Missouri 63131

*Patent Pending

PRO-SEARCH
Reaching The World

New Yaesu FT-102 Series

Transceiver of Champions!

The long-awaited new generation of Yaesu HF technology has arrived! New research in improved receiver filtering and spectral purity is brought to bear in the competition-bred FT-102, the HF transceiver designed for active Amateurs on today's intensely active bands!

Unique Cascaded Filter System

The FT-102 utilizes an advanced 8.2 MHz and 455 kHz IF system, capable of accepting as many as three filters in cascade. Optional filters of 2.9 kHz, 1.8 kHz, 600 Hz, and 300 Hz may be combined with the two stock 2.9 kHz filters for operating flexibility you've never seen in an HF transceiver before now!

All New Receiver Front End

Utilizing husky junction field-effect transistors in a 24 volt, high-current design, the FT-102 front end features a low-distortion RF preamplifier that may be by-passed via a front panel switch when not needed.

IF Notch and Audio Peak Filter

A highly effective 455 kHz IF Notch Filter provides superb rejection of heterodynes, carriers, and other annoying interference appearing within the IF passband. On CW, the Audio Peak Filter may be switched in during extremely tight pile-up conditions for post-detection signal enhancement.

Variable IF Bandwidth with IF Shift

The FT-102's double conversion receiver features Yaesu's time-proven Variable Bandwidth System, which utilizes the cascaded IF filters to provide intermediate bandwidths such as 2.1 kHz, 1.5 kHz, or 800 Hz simply by twisting a dial. The Variable Bandwidth System is used in conjunction with the IF Shift control, which allows the operator to center the IF passband frequency response without varying the incoming signal pitch.

Wide/Narrow Filter Selection

Depending on the exact combination of optional filters you choose, a variety of wide/narrow operating modes may be selected. For example, you may set up 2.9 kHz in SSB/WIDE, 1.8 kHz in SSB/NARROW, then select 1.8 kHz for CW/WIDE, and 600 Hz or 300 Hz for CW/NARROW. Or use the Variable Bandwidth to set your SSB bandwidth, and use 600 Hz for CW/WIDE and 300 Hz for CW/NARROW! No other manufacturer gives you so much flexibility in selecting filter responses!

Variable Pulse Width Noise Blanker

Ignition noise, the "Woodpecker," and power line noise are modern-day enemies of effective Amateur operation. The FT-102 Noise Blanker offers improved blanking action on today's man-made noise sources (though no blanker can eliminate all forms of band noise) for more solid copy under adverse conditions.

Low Distortion Audio/IF Stage Design

Now that dynamic range, stability, and AGC problems have been largely eliminated thanks to improved technology, Yaesu's engineers have put particular attention on maximizing intelligence recovery in the receiver. While elementary filter cascading schemes often degrade performance, the FT-102's unique blend of crystal and ceramic IF filters plus audio tone control provides very low phase delay, reduced passband ripple, and hence increased recovery of information.

Heavy Duty Three-Tube Final Amplifier

The FT-102 final amplifier uses three 6146B tubes for more consistent power output and improved reliability. Using up to 10 dB of RF negative feedback, the FT-102 transmitter third-order distortion products are typically 40 dB down, giving you a studio quality output signal.

Dual Metering System

Adopted from the new FT-ONE transceiver, the Dual Metering System provides simultaneous display of ALC voltage on one meter along with metering of plate voltage, cathode current, relative power output, or clipping level on the other. This system greatly simplifies proper adjustment of the transmitter.

Microphone Amplifier Tone Control

Recognizing the differences in voice characteristics of Amateur operators, Yaesu's engineers have incorporated an ingenious microphone amplifier tone control circuit, which allows you to tailor the treble and bass response of the FT-102 transmitter for best fidelity on *your* speech pattern.

RF Speech Processor

The built-in RF Speech Processor uses true RF clipping, for improved talk power under difficult conditions. The clipping type speech processor provides cleaner, more effective "punch" for your signal than simpler circuits used in other transmitters.

VOX with Front Panel Controls

The FT-102 standard package includes VOX for hands-free operation. Both the VOX Gain and VOX Delay controls are located on the front panel, for maximum operator convenience.

IF Monitor Circuit

For easy adjustment of the RF Speech Processor or for recording both sides of a conversation, an IF monitor circuit is provided in the transmiter section. When the optional AM/FM unit is installed, the IF monitor may be used for proper setting of the FM deviation and AM mic gain.

WARC Bands Factory Installed

The FT-102 is factory equipped for operation on all present and proposed Amateur bands, so you won't have to worry about retrofitting capability on your transceiver. An extra AUX band position is available on the bandswitch for special applications.

Full Line Of Accessories

For maximum operating flexibility, see your Authorized Dealer for details of the complete line of FT-102 accessories. Coming soon are the FV-102DM Synthesized VFO, SP-102 Speaker/Audio Filter, a full line of optional filters and microphones, and the AM/FM Unit.

Price And Specifications Subject To Change Without Notice Or Obligation

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The radio.

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YAESU Eastern Service Ctr., 9812 Princeton-Glendale Rd., Cincinnati, OH 45246 ● (513) 874-3100

EIMAC's 4CW300,000G Power Tetrode. A new generation of high-performance power tubes.

EIMAC's 4CW300,000G combines all the desired features transmitter designers look for: high peak plate current, low grid emission, low internal capacitances and low internal inductance. This is the first of a new generation of high performance power tubes for LF, HF, VHF and pulse service.

Laserfab pyrolytic graphite grids

The control grid and screen structures of the 4CW300,000G are precision-cut by a laser beam. Each element is monolithic and combines extremely low coefficient of expansion with low structural inductance. These features permit the 4CW300,000G to have a very high transconductance—10^6 micromhos—and allow efficient, high-frequency operation.

Rugged mesh filament

The EIMAC mesh filament provides exceptionally high peak plate current and permits low plate voltage operation. This leads to power supply economy, making the 4CW300,000G the economic choice for 300 KW AM broadcast service or long-pulse switch service, each of which demands a reserve of peak emission.

Improved anode structure

EIMAC's multi-phase cooling technique provides high plate dissipation to extract heat evenly and quickly from the anode, contributing to long tube life and operating economy.

EIMAC expertise

EIMAC's expertise in electron ballistics pyrolytic grid production, thermodynamics and circuit techniques combine to bring tomorrow's tubes for today's transmitter designs. More information is available from Varian EIMAC. Or the nearest Varian Electron Device Group sales office.

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